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THE BOTANICAL GAZETTE

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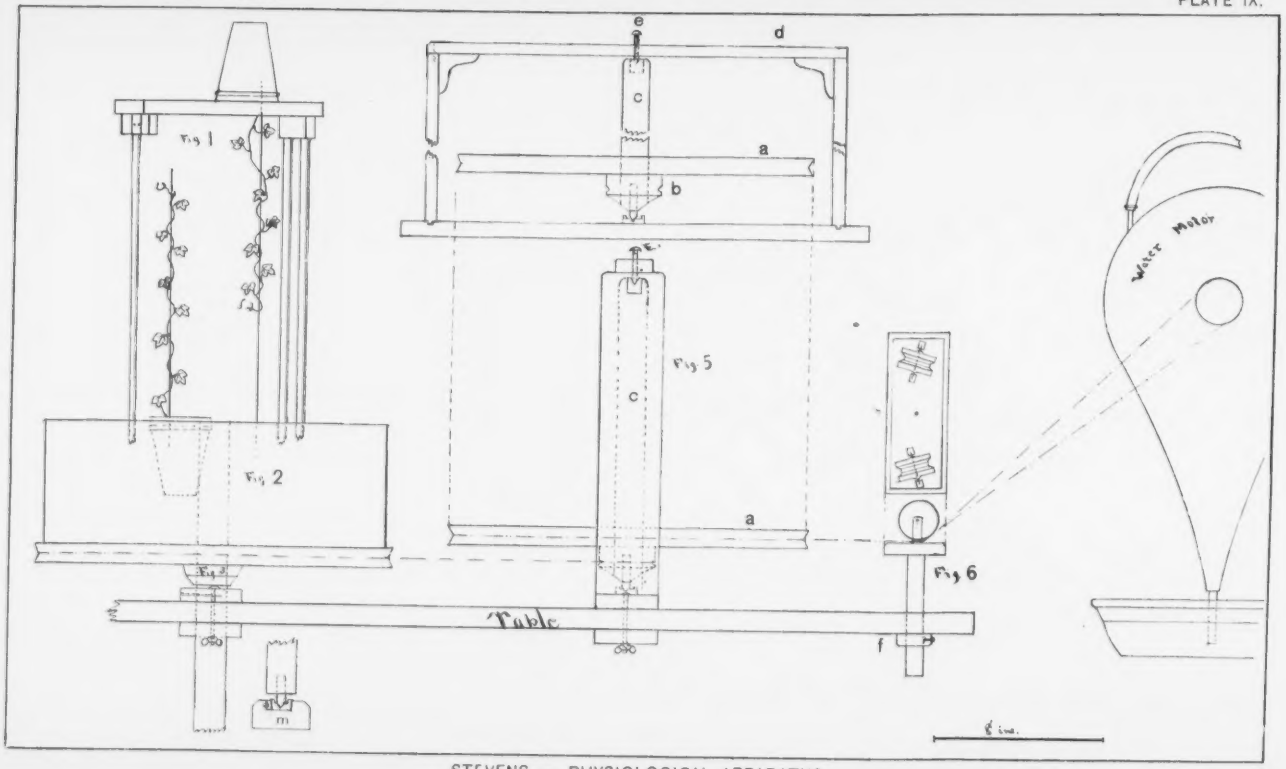
In the April number will appear:

Present problems in the morphology and biology of the Cactaceæ, by PROF. W. F. GANONG, *Smith College, Northampton, Mass.*

Notes from my herbarium, by WALTER DEANE, *Cambridge, Mass.*

Synopsis of North American Amaranthaceæ. III, by EDWIN B. ULINE and WM. L. BRAY, *Lake Forest University, Lake Forest, Ill.*



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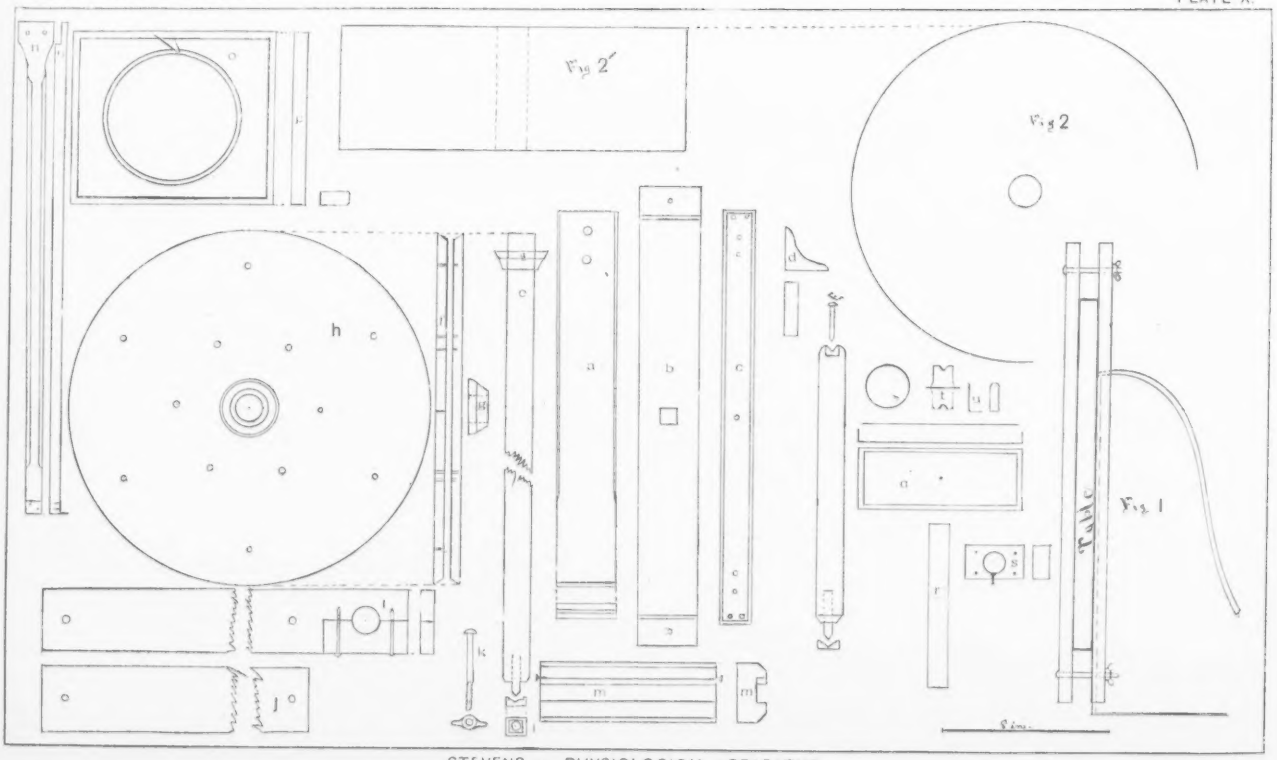

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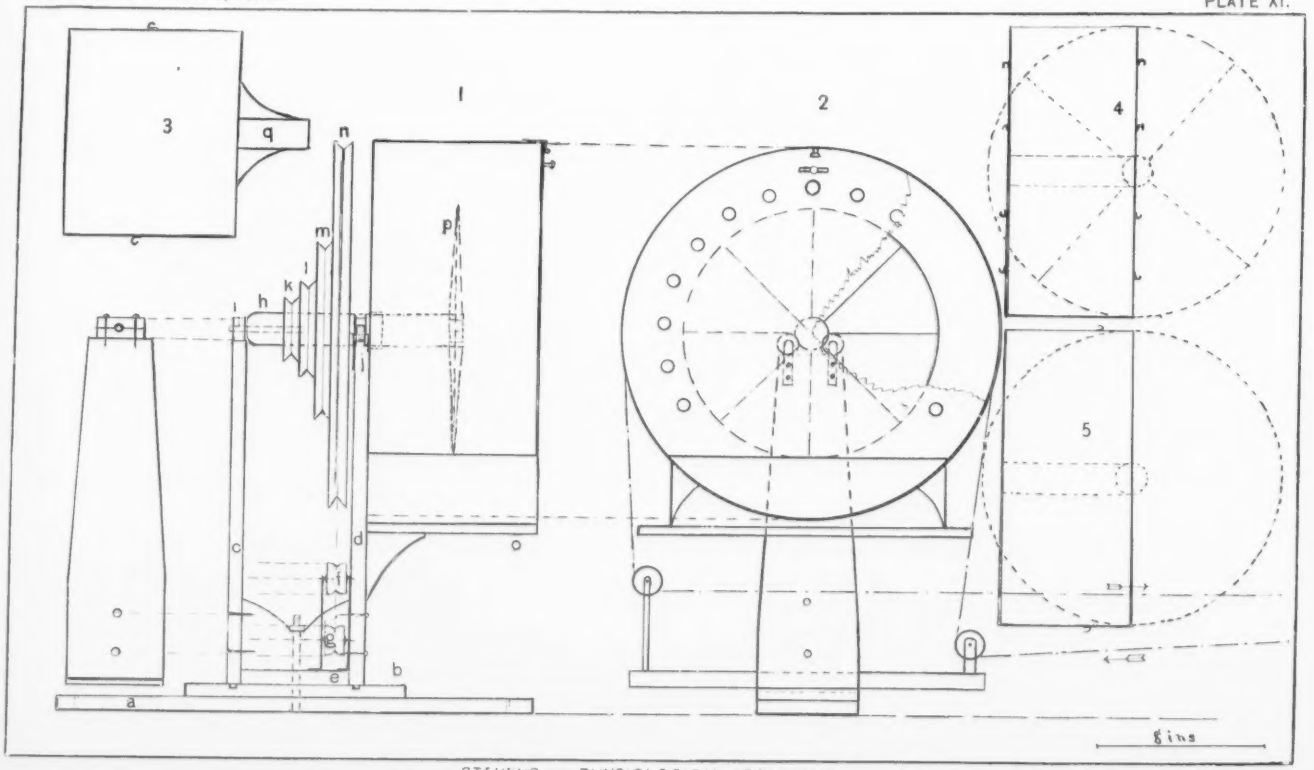

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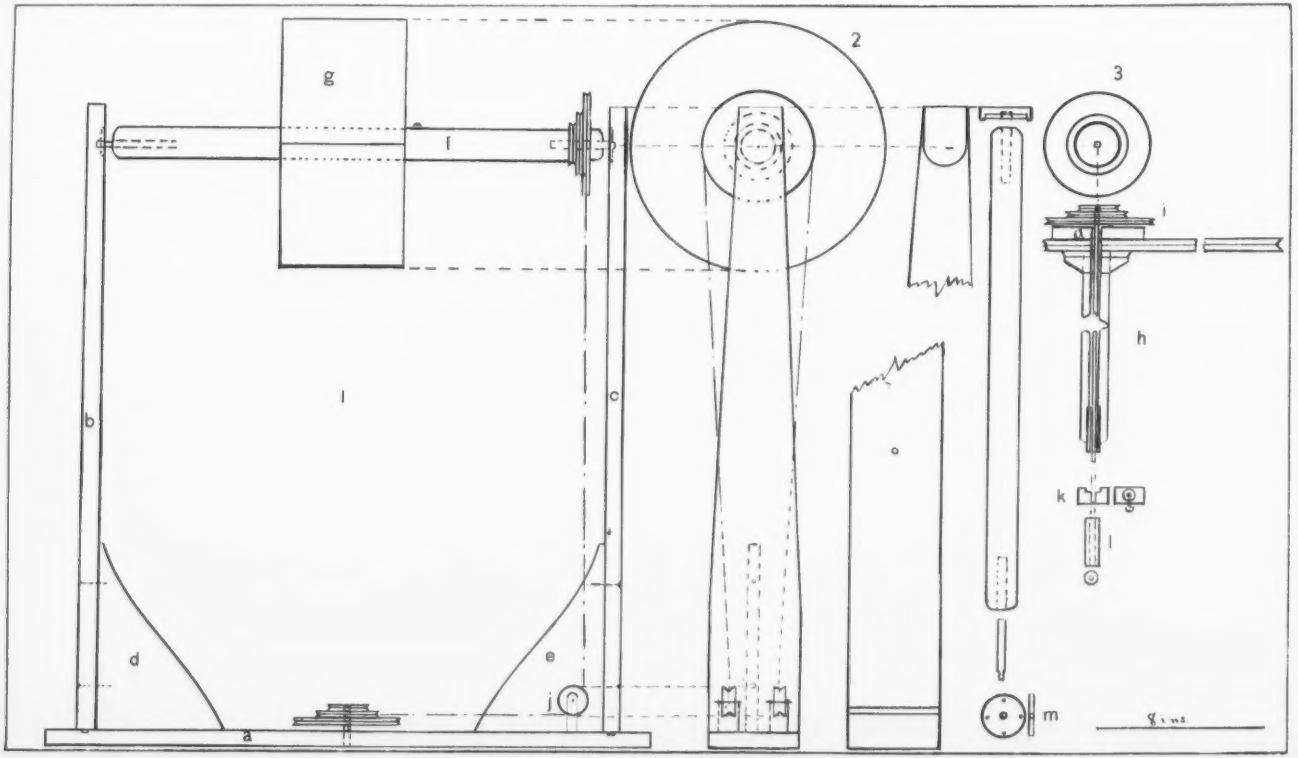

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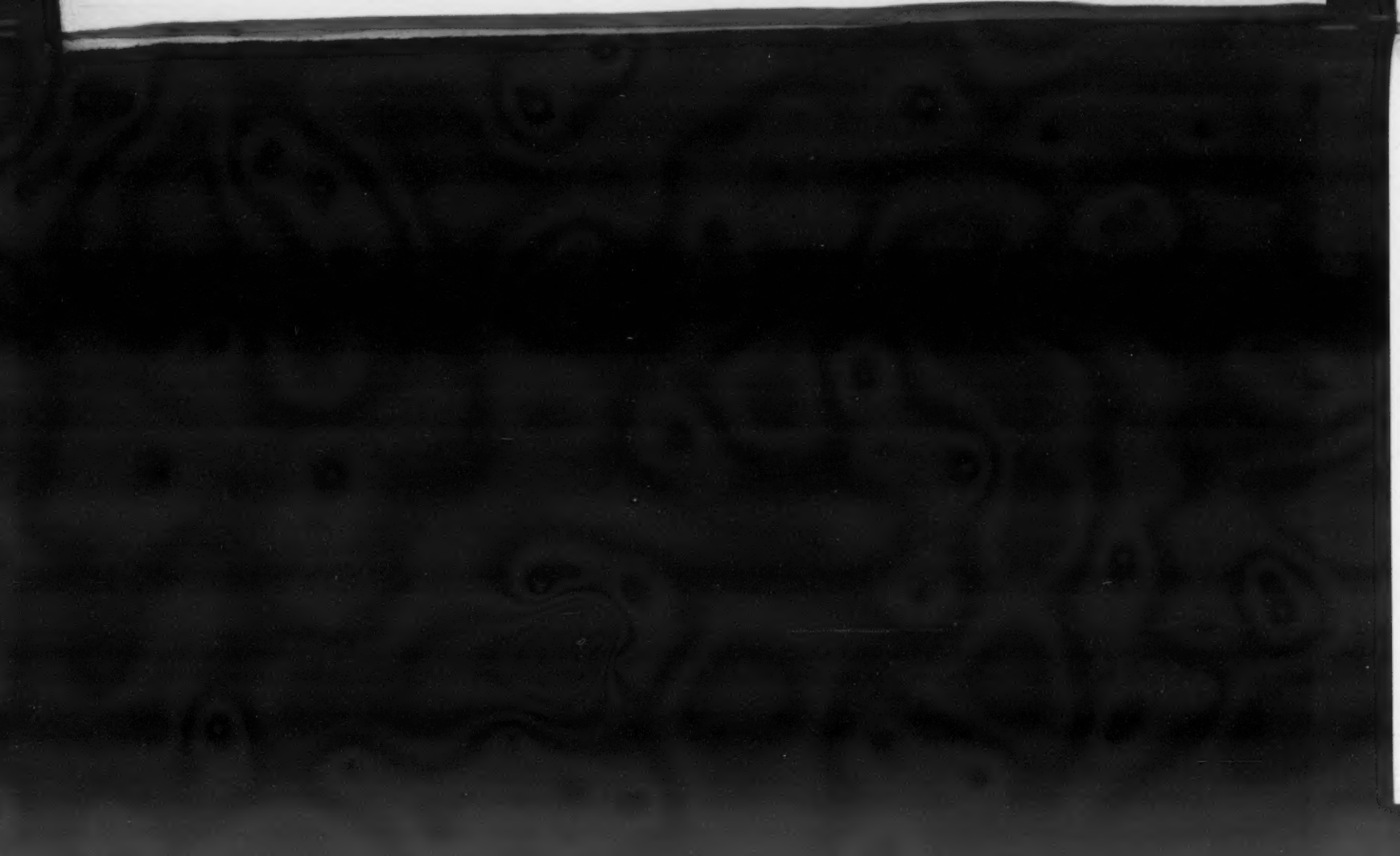

BOTANICAL GAZETTE

MARCH, 1895.

Apparatus for physiological botany.

W. C. STEVENS.

WITH PLATES IX–XII.

I propose to describe in detail some apparatus for physiological botany which I have found very useful in my laboratory. The description may at least serve as a useful suggestion here and there for those wishing to equip a physiological laboratory, but with scanty funds for the purpose.

The apparatus here described is made almost entirely of white pine and with ordinary wood working tools, including a lathe and scroll saw.

The table to which the apparatus is attached when in use consists of a single board one and one-half inches thick, seventeen inches wide and sixteen feet long, fastened by means of iron brackets on a level with the bases of two south windows, and twenty-eight inches from the floor. The table is set out on the brackets two and one-half inches from the wall. See plate X, figure 1.

CENTRIFUGAL MACHINE. Plate IX, fig. 5.—This consists of a wheel *a*, seventeen inches in diameter, which serves as a base for the pan containing the seedlings, and as a pulley for slow motion in other experiments; a small pulley *b*, two and one-half inches in diameter, to carry the belt from the motor when rapid motion is desired; an upright shaft *c*, one and one-half inches in diameter and fourteen and three-fourths inches in length exclusive of the steel cores; and a frame *d*, for mounting the pulleys and shaft as shown in the figures. Steel cores three-eighths inch in diameter are sunk into the two ends of the shaft. The upper core has its exposed end countersunk to admit the point of a large screw that has been tapered with a file while held in the lathe chuck. The core in the lower end of the shaft has been tapered in the same manner

as the screw, and fits into an iron piece, seven-eighths inch square and three-eighths inch thick, that has first been slightly hollowed with a five-eighths inch drill to form an oil cup, and then countersunk to receive the point of the core.

The construction of the frame which holds the shaft and pulley is made sufficiently clear by the figures of plate IX and by details *a*, *b*, *c* and *d* of plate X. The steps in the construction of the shaft and pulleys, however, need to be given. A pine stick 2×2 inches is sawed the proper length for the shaft; the centers of the ends are determined by crossing diagonals from the four corners; holes are bored in the center, and the steel cores are driven in, the upper flush with the surface and the lower protruding five-eighths of an inch. The stick is then fastened in the lathe by grasping the end of the lower core in the lathe chuck and bringing the dead center of the lathe into the depression countersunk in the upper core. The ultimate diameter of the shaft is to be one and one-half inches. The stick is now turned to a diameter slightly larger than this; a block is cut two and three-fourths inches square from two inch stuff; a hole one and one-half inches in diameter is bored through its center, and then the shaft is carefully trimmed with the turning gouge, or brought down with coarse sand paper until the block can be crowded on firmly. Then the block, in position flush with the end of the shaft, is turned to two and one-half inches in diameter. Then beginning three-fourths of an inch from what is to be its lower face the block is tapered down to the diameter of the shaft as shown in plate IX, figure 5, *b*. The upper face is made slightly concave, and a V-shaped groove is turned on the edge for the belt.

The pulley is now to be taken off, and after applying glue evenly over the space to be occupied on the shaft it is crowded into its position again. It is advised that the pulley be turned in position before gluing as above described because of the possibility of the block chipping too deeply while roughing off.

To make the large pulley, two pieces slightly over seventeen inches square are cut from one-half inch boards and screwed together with the grains crossing to prevent warping; the two surfaces are dressed true; the center is determined by crossing the diagonals; a circle is marked out from the center seventeen inches in diameter, and a one and one-half inch hole is bored through the center to fit the shaft.

The circle is now sawed out as accurately as possible on the scroll saw, and then trimmed if necessary with a spoke shave. A V-shaped groove for the belt may be cut on a former machine or with a hand beader. The pulley is now slipped on the shaft, crowded firmly against the small pulley and screwed to it. If the work has been carefully done it will be found when the shaft is adjusted in the frame that the apparatus revolves with perfect ease and accuracy.

A circular zinc pan is made of the diameter of the large pulley and six inches deep, with a tubular opening in the center one and one-half inches in diameter to fit over the pulley shaft. This can be seen in section in plate X, figures 2 and 2′, and in position on the clinostat table, to be described further on, in plate IX, figure 2.

To clamp the apparatus to the table it is placed with its base across the table with the ends of the base projecting on either side. A piece of the same size as the base of the frame, namely 3×22 inches, is passed under the table and the table is clamped between these two pieces by bolt and thumbscrew at either end as shown in plate X, figure 1.

To use the apparatus as a centrifugal machine for germinating seeds, the zinc pan is placed over the shaft so that it rests on the large pulley. It will be noticed that the shaft and pulleys can be removed for this purpose by simply unscrewing the large screw (*e*) fitting the upper end of the shaft. Fine white pine sawdust is put into the pan to the depth of four inches, and seeds of beans, peas, corn, etc., planted to a depth of two inches, about five inches from the center. The sawdust is thoroughly moistened and pressed firmly over the seeds; mosquito bar is then spread over the saw dust, and over this is placed wire netting with one inch meshes, so cut as to press snugly against the central zinc tube and the outer wall of the pan. This keeps the sawdust from heaping up against the sides of the pan while revolving rapidly, but does not press too hard against the seedlings, for the whole mass of sawdust loosens up to a considerable extent after the pan is set in motion. If any of the seedlings grow to the surface it is an easy matter to cut away the mosquito bar or even to separate the wire of the netting if this should happen to be in the way. A rubber tube connected with a siphon from a jar of water standing on a shelf above the apparatus is so clamped between two sticks screwed together as to allow a slow drip-

ping of water close against the central zinc tube. Here the centrifugal force is slight and the water has opportunity to soak in while slowly moving to the periphery. After a short time the water supply can be so adjusted as to compensate evaporation without sufficient excess to be thrown out around the side of the pan.

Seedlings of peas, beans and corn have been grown in sawdust in this manner for several days, revolving constantly at a rate of 180 revolutions per minute.

HORIZONTAL CLINOSTAT. Plate IX, figure 3, and details *e*, *f*, *g*, *h*, *i*, *j*, *k*, *l*, *m*, of plate X.—A wooden shaft, *e*, is turned $30\frac{3}{4}$ inches long and $1\frac{1}{2}$ inches in diameter, after a steel core has been inserted and then clamped in the lathe chuck in the manner previously described. A pulley, *g*, $2\frac{1}{2}$ inches in diameter, serving also as a shoulder for the larger pulley and table of the clinostat, *h*, is turned on the shaft in the manner previously described so that its upper face stands $\frac{3}{4}$ of an inch below the upper end of the shaft. The upper face is hollowed slightly. The table of the clinostat is made of the same size and in the same manner as that of the centrifugal machine, except that the central opening, $1\frac{1}{2}$ inches in diameter, extends only $\frac{3}{4}$ of an inch deep from the lower surface. This is crowded on the shaft against the small pulley and screwed to it. The core in the lower end of the shaft revolves in an iron bearing similar to the one described for the centrifugal machine. The bearing for the upper end of the shaft, shown in figure *i* of plate X, is made in the following manner: a piece is cut from $\frac{7}{8}$ inch stuff 3 inches wide and 27 inches long. Two inches from one end a hole is bored of the diameter of the shaft and a block is cut out through the middle of the hole as shown in the figure. When this is replaced with long screws it serves as an adjustable box for the shaft. To set up the clinostat, the last mentioned piece is laid across the table with the box end projecting inwards. Another piece seven-eighths inch by three inches by twenty-two inches is placed beneath the table and the two pieces are then clamped against the table by means of a bolt and thumbscrew, *k*, at each end of the two pieces. This method of clamping apparatus to the table is easy of execution and insures rigidity; it also affords a simple method of tightening belts by loosening the thumbscrew and slipping the apparatus along the table. The iron cup which receives the core

at the base of the shaft is adjustable along a groove in the block *m*, which is screwed to the floor. It will be seen that a wedge extends the full length of the groove and by driving in a screw at each end of the wedge the iron cup may be clamped in any position along the groove. I find that ordinary common twine makes an efficient belt. When the ends are tied the knot is so small as to be of no consequence. The slow motion for the clinostat is obtained by running a belt from the water motor to the large pulley on the centrifugal machine, and from the small pulley of the latter to the large pulley of the clinostat. The apparatus is shown harnessed in this way in plate IX. The zinc pan of the centrifugal machine may be put on the table of the clinostat as in plate IX, figure 2, and will there serve for imbedding the pots of the plants used in the experiments in moist sawdust to prevent rapid drying.

A support for inverted plants is shown on the clinostat in plate IX, figure 1, and in detail plate X, figures *n*, *o*, and *p*.

The method of adjusting the height of the belt from the water motor is shown in plate IX, figure 6. The standard carrying the pulleys is held at the desired height by means of a screw pressing against a strip of spring brass set into the block *f*, through which the standard passes. See plate X, details *q*, *r*, *s*, *t*, and *u*. The pulleys of figure 6 are shown set at the proper angle for the large pulley of figure 5. When the belt runs over the small pulley of figure 5 the pulleys of figure 6 are unscrewed and set nearly parallel and closer together.

In the preceding pages the methods of making the shafts and pulleys and of inserting the metal cores have been given in detail. It is now necessary to describe only the parts and manner of working of the following apparatus.

VERTICAL CLINOSTAT.—Plate XI, figs. 1 and 2 show the vertical clinostat set up for experiments with seedlings growing in a moist atmosphere. The base plate *a* is clamped to the table in the manner described on page 91. To the plate *b* are fastened the standards *c*, *d*, and the cross-plate *e*, to which the pulleys *f*, *g*, are fixed. The whole apparatus is bolted to the plate *a*, and may be turned about this at any angle to the light. The wooden shaft *h* has a steel core inserted in one end which bears in the iron box *i*. A depression is turned into the shaft five and one half inches from the

core-bearing end, to serve as a track for the small wooden wheels *j*. The shaft extends four and one half inches beyond the wheel bearings. Four pulleys, *k*, *l*, *m*, *n*, are fastened to the shaft in the manner already described (p. 91); the three smaller pulleys having been trued up on the lathe after being fastened to the shaft, and the large pulley, which is cut out on the scroll saw, being screwed to these. The pulleys *f*, *g*, which change the direction of the belt of the motor, can be adjusted along the plate *e* as desired. A zinc case, eighteen inches in diameter and eight inches deep, painted black on the inside, stands on the shelf *o*. A hole in the back of the case one and three-fourths inches in diameter permits the free end of the shaft to pass into the case. A narrow sleeve soldered to the opening shuts out the light. A light copper wire wheel *p*, twelve inches in diameter, is crowded upon the shaft and revolves with it inside the case. The case is water tight up to three inches from the bottom, and above this the whole of the front of the case is occupied by a door hinged at the base. Holes three-fourths inch in diameter and two inches apart are cut in the door in a circle of fourteen inches diameter. These holes may be opened and closed by a zinc strip placed behind them with corresponding holes, and operated by a knob.

Seedlings which have previously begun to germinate in moist white pine sawdust are fastened with two pins to large corks on the circumference of the wheel *p*. The seedlings are kept moist by passing through the water in the bottom of the case during a short period of their revolution.

With this apparatus the influence of light on the direction of growth of the stems and roots of seedlings may be studied with the influence of gravity eliminated.

When larger plants growing in pots are to be experimented with, the case and wire wheel are removed, and a zinc pan is put on the shaft. If it is desired to place a single plant with its long axis horizontal the pan shown in plate XI, fig. 3 is used. This is ten inches in diameter and eight inches deep. The tube *g*, soldered to the base of the pan and made rigid by brackets, fits over the shaft *h* and is held in position by a screw. The flower pot is imbedded in the pan in moist sawdust, and after fine excelsior has been placed over the sawdust and front of the pot the whole is bound in with a string passing over hooks soldered to the side of the pan. If sev-

eral plants are needed in one experiment the pan shown in fig. 5 is used. This is fourteen inches in diameter and six inches deep, and has a tube passing through the center which fits over the shaft *h*. The pots are imbedded in moist sawdust in a circle near the periphery and bound in as before. If however it is desired to place the pots so that the plants stand perpendicular to the axis of rotation the pan shown in fig. 4 is employed. This consists of two circular sides perforated at their centers and connected by a tube which fits over the shaft *h*, and by four partitions extending radially from the tube. When the plants are imbedded in moist sawdust as above described they do not require watering for a week or more even in the dry atmosphere of the laboratory.

UNIVERSAL CLINOSTAT. Plate XII.—The movement in a horizontal plane is obtained by a clinostat similar to the one described in the first paper, except that the shaft *h*, fig. 3, reaching to the floor, has a hole extending from end to end through the center, through which a three-eighths inch steel rod extends. To make this shaft, two strips the length of the shaft are cut two inches wide from one-inch stuff. Extending to a distance of three inches from the lower end of the shaft a groove is cut longitudinally through the middle of each strip five-eighths inch broad and five-sixteenths inch deep. The strips are then glued together, with the grooves facing each other and forming an opening five-eighths inch square in cross section. When the glue is dry, the upper end having been temporarily plugged, the shaft is put into the lathe and turned to one and one-half inches diameter. Then a three-fouths inch hole is bored two inches deep in the lower end of the shaft, and with a five-eighths inch bit this hole is continued to meet the five-eighths inch opening through the center of the shaft. A steel core *l*, three-fourths inch in diameter and two and one-half inches long, with a one-half inch hole longitudinally through it is inserted in the lower end of the shaft, one-half inch of its length protruding. The iron bearing *k*, fig. 3, has a depression one-fourth inch deep to receive the core in the lower end of the shaft, and a three-eighths inch hole one-half inch deep into which fits and is made fast by a screw the steel rod extending through the shaft. It will be seen that the steel rod remains stationary while the horizontal clinostat revolves about it. The upper end of the rod is made square and the three wooden pulleys

i are driven on and fastened with a screw. The base plate *a*, fig. 1, is screwed to the table of the horizontal clinostat, the steel rod playing through an opening in the plate. See figure 3. The uprights *b*, *c*, are made sufficiently rigid by the brackets *d*, *e*. Brass plates *m*, fig. 3, to serve as bearings for the steel cores of the shaft *f*, are mortised into the upper ends of the uprights and screwed fast. To put the shaft *f* in place the uprights are simply sprung apart.

A zinc pan similar to fig. 4, plate XI, is fastened upon the shaft *f* and the plants are bound in the manner already described.

Motion is communicated to the shaft *f* by a belt passing from the pulleys on the shaft to the pulleys of the stationary steel rod, so that the plants riding on the shaft *f* have a motion in a horizontal and a vertical plane at the same time.

With this apparatus the influence of both light and gravity is eliminated so far as they affect the direction of the growth of the plants.

The pieces of apparatus described are entirely efficient; they can be readily made by any one handy with tools, and the cost of the material used in their construction is merely nominal.

A water motor furnishes the best power for a botanical laboratory. An electric motor would be entirely satisfactory if one could connect with a dynamo running constantly night and day, or with reliable storage batteries, but a motor run by primary batteries is usually not desirable. Water motors furnishing sufficient power can be bought at very moderate prices.[1]

University of Kansas.

[1] I use the Little Giant water motor made by John Bolgiano, Baltimore, Md. No. 1 costing $5.00 will answer where there is a good head of water. I have only twenty-five feet pressure and use No. 2, costing $10.

On the "List of Pteridophyta and Spermatophyta of Northeastern America," prepared by the Nomenclature Committee of the Botanical Club.

B. L. ROBINSON.

In the discussions of the botanical nomenclature at the Rochester meeting of the American Association there was a decided feeling upon the part of many that more exact data were requisite to any satisfactory action. A series of rules was provisionally adopted and it was wisely urged that before the merits of the code could be estimated it would be necessary to see its application to some considerable part of our flora. Prof. Britton, at much expense of time and trouble, with the assistance of some others, has prepared under the above title a list of the flowering plants of the eastern states and Canada, selecting the names according to the Rochester code and its modification at Madison. This list possesses considerable interest, as it contains the expression of the latest phase of nomenclature reform in America and affords a much more satisfactory basis for the decision of the questions at issue than has hitherto been gained from vague generalizations and isolated instances.

In estimating the system of nomenclature illustrated by this list all considerations of sentiment may be passed with brief mention. It is natural that every working botanist should greatly regret giving up names long associated with certain plants, but there would certainly be few who would not make all due concession in this regard if really assured of a stable nomenclature as a reward of their sacrifices. Before leaving the matter of sentiment, however, it may be noted that it has not been confined to the conservative botanist, who regrets the proposed displacement of established names. It is equally exhibited by the reforming botanist, who maintains that he is impelled to make these changes by justice to the earlier authors. For slight examination shows that this idea of justice is often of the sentimental rather than the practical sort. The revival of old and obscure names undoes in many instances the most careful work of subsequent authors, and this, too, from no fault of theirs, for the rules affecting their

work were not invented until many years after its publication. Certainly this is a robbing Peter to pay Paul principle of justice. That there have been many cases of arbitrary change and consequent injustice in the past no one will deny, but it is very doubtful whether these injuries can be righted at present by making more arbitrary changes. Certainly the reform exhibited in the present list does not altogether tend to perpetuate the older combinations of the injured authors, but much more to the renaming of a considerable portion of our flora and the forming of a multiplicity of entirely new combinations with new authorities. But passing these considerations, which as they do not directly affect the practical side of nomenclature may perhaps be regarded as sentimental, we come to the more important question: Is the new system one which possesses the elements of permanency?

It is one of the principal arguments for the stability of the proposed code that it is a *rigid* one, which permits no exceptions and, to use an expression of a leader in nomenclature reform, "leaves nothing to individual judgment." It is well-known, however, to every working botanist that even the selection of the first specific name, after the still more difficult choice of the generic, involves a constant exercise of judgment of the most critical sort, both as regards the exact application of brief and unsatisfactory descriptions and the often doubtful priority of publications. Even the form of the name is sometimes subjected to individual judgment or arbitrary modification in the new system as well as the old, as an illustration will show. It has occurred to a number of writers that the sweet alyssum, common in cultivation, should be separated as a distinct genus. The history of its synonymy is as follows: Upon page 420 of his *Familles des Plantes*, in 1763, Adanson sets up the genus *Konig*, founded upon *Clypeola maritima* L. (*Alyssum maritimum* Lam.), with little description and largely by referring by number to the species of Linnæus. In 1814 Desvaux, also of the opinion that the Lamarckian *Alyssum maritimum* should be separated from the other alyssums, carefully described it under the correctly latinized name *Lobularia*. In 1826, Robert Brown revived the name *Konig*, modifying it to *Koniga* and dedicating the genus to a friend, then curator of the British Museum, whose name by a strange chance was Konig (anglicized from König). In 1891, Prof. Prantl, revising the CRUCIFERÆ for the *Nat. Pflanzenfamilien*,

wisely selects as the correct designation of the genus the first properly latinized name *Lobularia*. Now Prof. Britton takes a rather singular course by pronouncing Adanson's *Konig* a misprint for *Koniga*. This action is entirely unwarranted by fact, both from the circumstance that *Konig* occurs in same form several times in Adanson's work and on account of that author's well-known disregard for latinization. Prof. Britton takes this as an entirely arbitrary expedient for setting up a name which would otherwise from its uncouth form be deservedly neglected. But what must be the outcome of such arbitrary actions as this? Is nothing here left to individual judgment? How can Prof. Britton be sure that *Konig* is a misprint for *Koniga* and not for *Konigus*, *Konigium* or *Koniganthus?* Is it likely that other authors will agree upon this point? But this is not all. If Prof. Britton may coin from an unlatinized word a generic name, how may an erratic writer be prevented from taking up any vernacular name from English or German, Dutch or Russian, if having discovered its use in some work of the last century he only pronounces it a misprint, and by the ready addition of an *us*, *a*, or *um* uses it to displace a later generic name? A system which upon the precedent of its chief exponent permits such vagaries as this is certainly not likely to have the desired stability.

The choice of *Koniga* as the earliest generic name is noteworthy as illustrating another point. It will be remembered that at Madison special legislation was demanded and secured to establish the so-called principle of priority by position, according to which if two genera or two species are published in the same work and subsequently united, the name standing first in the book is the authorized one, there being no difference in the time of publication. Now although *Konig* is used on the 420th page of Adanson's work to designate the sweet alyssum, that author states in an erratum that the reader is to substitute for *Konig*, *Aduseton*. A radical reformer might, it is true, refuse to Adanson the right to take back a name once published, but the peculiar feature of this case is that the errata of this work, while doubtless written after its completion, have been uniformly bound in front of the regularly numbered pages; at least such is the case in the three copies of the work accessible to the writer. Thus Adanson's correction, advocating *Aduseton*, has many pages of what Prof. Britton has termed priority of position over the description of *Konig*.

The case is interesting merely as a good instance of many in which zeal in searching for the earliest designation leads to the consideration of names so involved that several interpretations are equally possible. In passing it may also be noted that Prof. Britton's *Koniga maritima* is long antedated by the same combination by Robert Brown, a writer whose works the reforming botanists can scarcely afford to overlook.

It will be generally admitted that a system of nomenclature is unsatisfactory in which the botanist who characterizes and names a new species with all due care that he is not duplicating an existing name, nevertheless can not be at all sure but that the name so carefully chosen may at once be displaced through no fault of his. Yet such is the case under the Rochester and Madison rules. When Nuttall made the combination *Chrysopsis pilosa*, it was a new binomial applied to a good new species evidently belonging to the genus under which it was placed, and never before described in this or any other genus. Can any author hope in describing a species in the future to do better than this? Under the long established usage of conservative botanists such a name would be inviolable; under the Madison rules, however, Prof. Britton is able to displace it by combining the same specific name to the same generic but to designate an entirely different plant, namely *Chrysopsis pilosa* Britton (*Erigeron pilosa* Walt.), making thereby a most useless and pernicious synonym of Nuttall's name, which has every right to stand.

It is not the special case that is here important, but the general principle, which permits such changes and will continue to permit them in the future. The upheaval of nomenclature under this law will not cease even when most of the obscure names of the past have been sought out. It will always be possible for a botanist through perfectly conscientious work to readjust generic lines so that species of the same specific name are thrown together. In such cases under the prevalent usage that species which was already under the genus retained stands fast. But according to the Madison rule, as we have just seen, if the species brought into the genus chances to have an older specific name than the species already in the genus, both plants are to be re-named instead of only one. It does not seem to have occurred to the reformers that this ruling, far from being conducive to stability, would,

especially when combined with another of their dicta, give perpetual opportunity for change, since it will always be possible for an erratic botanist to throw together large genera like *Aster* and *Erigeron*, *Bidens* and *Coreopsis*, *Panicum* and *Paspalum*, thereby displacing many specific names which according to the rule of "once a synonym always a synonym" can never be revived! This outcome seems so preposterous that it must be stated that it is not merely the writer's own unauthorized interpretation but the distinctly expressed although unpublished view of one of the compilers of the list, who has been among the foremost in the cause of nomenclature reform.

It is impossible here to criticise in detail the bibliographical work in the list. It is well known that it has been done gratuitously by those who, pressed with other duties, could ill afford the time, so that slips may well be overlooked. Nevertheless it must be confessed that it is disappointing to find such obvious evidences of haste, not to say carelessness, in this regard. Why, for instance, should *Iodanthus pinnatifidus* be ascribed to Prantl when it was used long ago in Steudel's *Nomenclator* (with synonym), again by Gray in the Proceedings of the American Academy, again by Watson in the Botany of the King Expedition? The fact that Prantl himself was ignorant of these earlier publications is but a poor excuse for an American botanist well armed with Watson's *Bibliographical Index* or the recently issued *Index Kewensis*, in both of which the combination is cited. Or why should the place of publication of Celokowski's genus *Stenophragma* be given as Œsterr. Bot. Zeitschr. **27**: 177, where there is merely a review by Dichtl of Celokowski's *Flora von Böhmen*, while the publication of the genus was not even in this latter work, but some years before in the *Regensburg Flora?* However, every one should be aware of the great difficulty of freeing such a list from errors of this kind.

A more significant fact in regard to the work is the number of changes of name which have resulted from readjustments of generic lines and from a modified conception of the dignity of the species. It cannot fail to strike the botanist who glances over this list that many of its species are founded upon plants which by such experienced botanists as Hooker, Gray, Watson, and others have generally been regarded as varieties. Of course it is not denied that the reverse case often obtains. A corresponding change (and here a distinct depreciation) in the dignity of the variety is shown by Prof.

Britton's many "albifloras," covering forms of which Dr. Gray, in a letter recently published, wrote: "When the new edition of the Manual comes out it will have a *nota bene:* Expect a white-flowered state of every colored species. They are sure to turn up sooner or later. And I find it no good therefore to say var. *alba* over and over." If it should be urged that, upon the basis of former publications, *Gerardia purpurea albiflora* Britton, *G. tenuiflora albiflora* Britton, *Gentiana Andrewsii albiflora* Britton, etc., are to be regarded merely as forms and not as varieties, it may be asked whether the trinomial system adopted in the list has not a considerable defect if it cannot indicate the difference between a well-marked variety and a mere form. Whether the naming of forms is at present desirable may well remain an open question, but there can be no doubt that such a course is a general tendency of exhaustive systematic study, and accordingly a style of nomenclature in which there is no distinction between subspecific, varietal, and formal differences is likely to appear to future botanists a rather clumsy tool. However, to return to the interpretation of groups, I would not be taken as even hinting that every botanist has not a perfect right to put his own construction upon the limits of genera, species, and varieties. But it should be apparent to those sanguine supporters of reform, who hope to derive stability from it, that here again everything depends upon individual judgment and must always do so.

In the light of what has been said, it seems sufficiently evident that the new system, far from furnishing a satisfactory solution to the nomenclature question, fails even to offer such substantial advantages over the existing system as greater clearness and prospect of permanency, for which alone working botanists could afford to make such sweeping changes in their language. It is readily granted that the Rochester and Madison rules were formed with care, and with earnest hope of securing uniformity. But they represent what may be expected of rigid codes. Exact rules cannot be consistently applied to such varying circumstances without leading to many incongruities, especially when such action is made retrogressive. It is worthy of note that even Dr. Kuntze, who has certainly made the greatest effort to be consistent, has recently objected strenuously to the principle of "once a synonym always a synonym," expressing grave doubts whether after all several hundred genera and some thousands of species should be renamed on account of rules invented long after their publication.

Uniformity, consistency and stability of nomenclature are in the opinion of the writer unattainable. The sanction of particular associations will never make rules able to control all authors. There will, it is true, be those whose sanguine ideas lead them to follow with conscientious zeal a proposed new system; there will also be those who, however unpopular they may make themselves, will hesitate to change to what they are confident cannot be permanent; and there will always be a third class, who at once set about modifying and improving the measures proposed. This third element is of course the serious obstacle to successful reform, since its existence dispels all hope of a permanent system. It will be remembered in this connection that within a year after the Madison convention a prominent radical member, who assisted in framing the Madison rules, was publishing extensively upon an entirely different system.

While this view of nomenclature may seem unduly pessimistic it may be said in its justification that there is a much more important quality of nomenclature than stability and consistency, namely that of ready intelligibility. It has of late been the fashion among the reforming botanists to decry the existing nomenclature as hopelessly involved and confused. Strangely enough this cry comes quite as often from the physiologist and anatomist as the systematist. It arises, however, in great part at least, from a misapprehension, since the working monographer, who is studying the plants themselves, is seldom seriously troubled in understanding the nomenclature of former writers. The difficulties which confront him are much more those of variation in plants, fragmentary types or insufficient description, etc., and not those of nomenclature pure and simple. Nor has the writer of today any difficulty in conveying accurately his ideas of plant relationship through the medium of the existing nomenclature. For instance no writer using the well established name *Calycanthus* could be misunderstood, while the names *Beurera*, *Butnera*, and *Büttnera*, recently advanced for the genus, never can be more intelligible than the one in use, and the very fact that these three names have within as many years been successively brought forward, each as the only correct designation of the genus, affords little encouragement to think that any one of them is likely long to replace the old and familiar name.

Cambridge, Mass.

Flowers and insects. XIII.[1]

CHARLES ROBERTSON.

DODECATHEON MEADIA L.—American cowslip, shooting-star. In his arrangement of floral mechanisms Delpino (2) recognizes a class of pendulous nodding or horizontal flowers upon which the visitors cling (apparrecchi prensili), which he divides into the borrage and the verbascum types (tipo borragineo, tipo verbascino). The former includes such flowers as *Dodecatheon*, *Cyclamen*, and *Solanum*, which the bees clasp in such a way as to receive the pollen upon the undersides of their bodies, and the latter contains flowers like *Verbascum* and *Tradescantia*, which are provided with hairs which afford a foot-hold.

Kerner (1) regards the reflexed petals as facilitating access to nectar and pollen, and this is true as regards the legitimate visitors. Intruders are much more effectually excluded than would be the case if the petals were less strongly reflexed, as in the flowers of *Erythronium*.[2] The approximation of the anthers in a compact cone also gives the flower a signal advantage over such a flower as *Ribes gracile*,[3] whose stamens being of the ordinary form permit the visits of a number of insects which the flower cannot utilize. The reflexed petals also render the nodding flowers much more conspicuous and attractive than they would be if the expanded petals faced the ground.

Loew (3) has figured and thoroughly described *Dodecatheon integrifolium* Michx. (=*D. Meadia* L.), *D. Jeffreyi* Moore (=*D. Meadia* var. *lancifolium* Gray), and an unnamed species from material growing in the Berlin Garden. To this I shall add an account of *D. Meadia* as observed under natural conditions in Illinois. The plant is common in prairies and open woods, where it grows in rather large patches. The scapes rise from 3 to 6^{dm} and bear numerous, handsome flowers, which are white or rose color. The corolla has a short tube, which for

[1] Contributions to an account of the ecological relations of the entomophilous flora and the anthophilous insect fauna of the neighborhood of Carlinville, Illinois.

[2] Bot. Gaz. **17**:69. 1892.

[3] Ibid., 270.

about 3^{mm} is united with a tube formed by the monadelphous filaments. After separating from the stamen tube it is bent upon itself, and its lobes are strongly reflexed. At the flexure it is strongly thickened and marked with dark reddish purple. This portion of the corolla forms a foot-hold for the bees to cling to while sucking. The tube formed by the united filaments is about 5^{mm} long. The anthers are very rigid and are so closely approximated that they form a cone from 8 to 10^{mm} long. Exteriorly the stamen-tube is yellow, but the base of each anther is swollen and marked with dark purple. This part also serves as a foot-hold and as a path-finder. The stamen-tube with its cone of rigid anthers serves to conceal the nectar and to render it quite deep seated, for to reach the sweets the bees must force their proboscides between the anther tips.

The flowers are homogamous. Cross-pollination is secured by the stigma being 2 or 3^{mm} in advance of the anthers and having its surface directed away from them. According to Loew (3) spontaneous self-pollination may occur when the corolla falls.

During the blooming season, April 24 to May 24, the plant is in competition more or less severe with the following flowers, which are also adapted to bumblebees, no mention being made of those whose seasons overlap for only a short time with the first or last part of the season of *Dodecatheon:*

Delphinium tricorne, Geranium maculatum, Aesculus glabra, Astragalus Mexicanus, Baptisia leucophaea, Pyrus coronaria, Rubus villosus, R. Canadensis, Triosteum perfoliatum, Hydrophyllum Virginicum, Mertensia Virginica, Pentstemon pubescens, Monarda Bradburiana, Orchis spectabilis, Uvularia grandiflora and the introduced Trifolium pratense, Robinia Pseudacacia and Nepeta Glechoma.

The phaenological position of *Dodecatheon* exposes its flowers to bumblebee females, the workers only beginning to appear as the blooming time expires. It coincides pretty nearly with the flight of *Anthophora ursina,* and later overlaps with the early part of the flight of *A. abrupta. Synhalonia speciosa* and *S. belfragei* and *Osmia bucephala* fly throughout the period. These are the only long-tongued bees which could be expected to visit the flowers in my neighborhood. May 2, 5 and 8 I saw the flowers visited by the following:

Hymenoptera—*Apidæ:* (1) Bombus americanorum F. ♀, s., ab.; (2) Anthophora ursina Cr. ♀, s. and c. p.; (3) Synhalonia speciosa Cr. ♂, s., *Andrenidæ:* (4) Augochlora pura Say ♀, c. p., one.

Lepidoptera—*Rhopalocera:* (5) Colias philodice Gdt., s.

On the literature of *Dodecatheon* see:—
(1) Kerner, Die Schutzmittel des Pollens gegen die Nachtheile vorzeitiger Dislocation und gegen die Nachtheile vorzeitiger Befruchtung 38. 1873. Sep. a. d. Berichten des naturw. med. Vereines zu Innsbruck 2 and 3:—.1872.—(2) Delpino, Ulteriori osservazioni sulla dicogamia nel regno vegetale Pt. 2. fasc. 2: 295. 1875. Estratto dagli Atti della Soc. Ital. delle Sci. Nat. in Milano 16 and 17:—.1873–1874.—(3) Loew, Blüthenbiologische Beiträge I, 17–21. Sep. aus Pringsheim's Jahrbucher 22:—.1891. (Abstract in Just's Bot. Jahresbericht 19[1]: 416.)

STEIRONEMA CILIATUM Raf.—The observations which have been recorded seem to show that the adaptation for cross-pollination in *Lysimachia* and *Steironema* consists in the stigma being so far advanced above the anthers that self-pollination never or rarely occurs, as in Müller's large form of *L. vulgaris* (3, 16), or from proterogyny, as in *L. thyrsiflora* (Warming 10 and MacLeod 24) and in our *S. lanceolatum*, *longifolium* (23) and *ciliatum*. A less conspicuous form of *L. vulgaris*, which grows in situations unfavorable for insect visits is regularly self-fertile. Other species are homogamous and self-pollinating, as *L. nummularia* (Warming 10) and *nemorum* (Kerner 22).

According to Bonnier (11) in *L. vulgaris* nectar is secreted by the ovary and escapes through stomata in the epidermis, but in most cases it is wanting, or exists in quantity imperceptible by ordinary means, though the visits of male bees seem to indicate its presence (3, 16, 23). The part played by the papillæ in the attraction of insects (Kerner 22) is even more doubtful. I have seen no evidence of this in our species. The pollen is by far the most important, for by attracting the females of *Macropis* it has given rise to an interesting case of mutual economic correlation. Our species of *Steironema* (23) and the European *L. vulgaris* (3, 16, 24, 27) and *punctata* (4) are visited almost exclusively by bees of this

[1] As a substitute for a more extended review it is proposed to give an index to the literature of each genus, arranged chronologically, and it is hoped that the index will contain at least the principal references. Use has been made of the Bibliography compiled by D'Arcy W. Thompson, published in the translation of Müller's Befruchtung der Blumen, and giving the titles of books, etc. published up to 1883; of MacLeod's continuation of Thompson's list for the period 1883-1889, Bot. Jaarboek, 1890; of the abstracts by Müller and Dalla Torre in Just's Bot. Jahresbericht and those of Ludwig and others in the Bot. Centralblatt. I am under obligations to Prof. Wm. Trelease for access to the literature contained in the library of the Missouri Botanical Garden.

Abstracts are not cited unless they contain information on the genus being indexed. Information about contents of papers, etc., when given in the text, is not repeated in the index.

genus. I have mentioned (23) the flowers on which species of *Macropis* have been observed. Patton (12) states that Dufour found both sexes of *M. labiata* on flowers of *Alisma plantago*, and Schenk one or both on *Bryonia*, *Rubus caesius*, *Cirsium arvense* and *Picris*, but no one has seen a female *Macropis* collecting pollen of any flower except *Lysimachia* and *Steironema*.

Steironema ciliatum agrees in all essential particulars with *S. lanceolatum* (23). It grows taller and has larger flowers. In Connecticut Patton (13) saw the flowers visited by *Macropis ciliata* Pttn. ♀ and by *M. patellata* Pttn. ♂. In Illinois I have seen them visited by *M. steironematis* Rob. ♂♀, the female collecting pollen. The latter bee does not seem to have a decided preference for yellow, for all of the other flowers I have taken it on are white (23).

On the literature of *Lysimachia and Steironema* see:—

(1) Sprengel, Das entdeckte Geheimniss der Natur im Bau und in der Befruchtung der Blumen. 1793. *L. quadrifolia* and *vulgaris*, 104. —(2) Kerner, Die Schutzmittel des Pollens 27. 1873.—(3) Müller, Befruchtung der Blumen durch Insekten. 1873. *L. vulgaris* and *nummularia*, 348–9.—(4) Delpino, Ulteriori osservazioni nel sulla dicogamia regno vegetale Pt. 2. fasc: 1: 212, 321. Estr. dagli Atti della Soc. Ital. d. Sci. Nat. 17:—.1874. Visits of *Macropis* to *L. vulgaris* and *punctata* observed by Piccioli, Müller and Delpino in Westfalia, at Firenze and Vallombrosa.—(5) Lubbock, British wild flowers considered in relation to insects. 1875. *L. vulgaris*, visits of *Macropis*, 21; Müller's two forms, 126.—(6) Darwin, The variation of animals and plants under domestication 2: 154. 1876. 2d edit. *L. nummularia*, sterility.—(7) Darwin, The different forms of flowers on plants of the same species. 1877. *L. vulgaris*, Müller's two forms, 4, 342.—(8) Müller, Das Variiren der Grösse gefärbter Blüthenhüllen und sein Einfluss auf die Naturzüchtung der Blumen. Kosmos 2: 11–25, 128–139. 1877. *L. vulgaris*. (Abstract in Just's Bot. Jahresbericht 5^1: 740.)—(9) Henslow, On the self-fertilization of plants. Trans. Linn. Soc. II. Bot. 1: 328, 377. *L. vulgaris*, Müller's two forms. 1877.—(10) Warming, Smaa biologiske og morfologiske bidrag. Bot. Tidsskrift III. 2: 108–130. 1877. (Just's Bot. Jahresbericht 5^1: 745–6.)—(11) Bonnier, Les Nectaires. Extrait des Ann. des Sci. Nat. Bot. VI. 8: 140. 1879. (Just's Bot. Jahresbericht 7^1: 120.)—(12) Patton, Observations on the genus Macropis. Am. Journ. Sci. and Arts. III. 18: 211–14. 1879. *L. vulgaris* and *S. ciliatum*. (Just's Bot. Jahresbericht 7^1: 145.)—(13) Patton, Description of the species of Macropis. Ent. Monthly Magazine 17: 32–33. 1880.—(14) Dufour, Existence de tensions chez certaines fleurs. Étude d' anatomie et de physiologie végétales, desertation inaugurale, 42–46. 1882. (Just's Bot. Jahresbericht 9^1: 500.)—(15) Müller, Weitere Beobachtungen über Befruchtung der Blumen durch-Insecten 3: 65. 1882. Scp. aus dem Verh. des naturhist. Ver. der. preuss. Rheinl. u. Westf. *L. vulgaris*, visitors.—(16) Müller, The fertilization of flowers

389–390. 1883. *L. vulgaris*, pollination, *L. nummularia* and *thyrsiflora*, ref. (6) and (10).—(17) MacLeod, Untersuchungen über die Befruchtung einiger phanerogamen Pflanzen der Belgischen Flora. Bot. Centralblatt **23**: 366. 1885. *L. vulgaris*, autogamy. (Just's Bot. Jahresbericht **13**[1]: 740.)—(18) MacLeod, Nouvelles recherches sur la fertilisation de quelques plantes phanérogames. Arch. de Biol. **7**: 156. 1886. *L. vulgaris*.—(19) Kirchner, Neue Beobachtungen über die Bestäubungseinrichtungen einheimischer Pflanzen. Progr. des 68 Jahresfeier der kgl. Württemb. landwirtsch. Akademie Hohenheim. 1886. *L. nemorum*, no nectar. (Just's Bot. Jahresbericht **14**[1]: 791.)—(20) Jordan, Die Stellung der Honigbehälter und die Befruchtungswerkzeuge in den Blumen 51. Sep. aus Flora **69**: 1886. *L. punctata*, nectar receptacles of doubtful occurrence.—(21) Halsted, Observations upon pollen measurements. Bull. Torr. Bot. Club **16**: 135. 1889. *S. lanceolatum*, (Just's Bot. Jahresbericht **17**[1]: 523.)—(22) Kerner, Pflanzenleben. **2**:—. 1891. (Just's Bot. Jahresbericht **17**[1]: 528. **18**: 484.) *L. ciliata* Protection of pollen by nodding of fls., 118. *L. thyrsiflora, ciliata*, attraction by papillæ, 166. *L. nemorum*, spontaneous self-pollination, 338. *L. nummularia*, 398.—(23) Robertson, Flowers and insects. X. Bot. Gaz. **18** 47–48. 1893. *S. lanceolatum, longifolium, ciliatum, L. quadrifolia, vulgaris, nemorum, nummularia.* (Bot. Centralblatt **55**: 101.)—(24) MacLeod, Over de bevruchting der bloemen in het Kempisch gedeelte van Vlaanderen. Bot. Jaarboek **5**: 443–444. 1893. *L. vulgaris, nemorum, nummularia, thyrsiflora.* (Bot. Centralblatt **56**: 177.)—(25) Knuth, Blumen und Insekten auf den Nordfriesischen Inseln 120. 1894. *L. vulgaris*, autogamous form on Sylt.—(26) Loew, Blütenbiologische Floristik des mittleren und nördlichen Europa sowie Grönlands. 1894. *L. vulgaris*, 161. *L. nummularia, nemorum, thyrsiflora, ciliata*, 319.—(27) Knuth, Weitere Beobactungen über Blumen und Insecten auf den Nordfriesischen Inseln. Schr. d. Nat. V. f. Schleswig-Holstein **10**: 229, 239. 1895? Correlated presence or absence of *Macropis* and *Lysimachia* on certain islands, etc.

ENSLENIA ALBIDA Nutt.—The plants are common on creek-banks, often climbing high, and blooming from July 12th to August 22. The flowers are white and are arranged in small umbel-like clusters. The petals are erect, and their tips are bent aside, out of the way of the passage leading to the nectar. The divisions of the crown are petal-like and erect, the central portion being produced above into two long appendages. On each side there is a wing-like portion which is grooved on the inner face, where the nectar is secreted and lodged. Each wing-like part, with the one of the next division forms a more or less well defined passage, which guides the bee's proboscis to the nectar. This is situated so near the angles of the wings of the approximated anthers that, when the proboscis is withdrawn, some slender appendage is quite likely to be caught between the divergent angles of the anther wings and guided by them into the cleft of the little black corpusculum which lies at the top of the slit. The gynostegium is quite slender and is tipped by five white

appendages. These, with the ten flexuous tips of the crown divisions and the five erect petals, give the flower a soft, white appearance and conceal the complicated mechanism within, while they also render a little more evident the passage which leads to the nectar.

When a corpusculum with its pair of pollinia is withdrawn, it shows an unusually short retinaculum, which from its attachment to the corpusculum curves outward and a little downward and is inserted a little below the apex of the pollinium. The apex of the pollinium thus forms a very conspicuous knee, which stands at right angles to the axis of the corpusculum, and this knee is the part which is caught by the anther wings and thus causes the insertion of the pollinium. I find no evidence whatever that the original appendage to which the corpusculum becomes attached ever again enters the slit, or that the pollinia are introduced in pairs. When the pollinia are thoroughly dried, their planes are commonly perpendicular to each other, or they sometimes lie in nearly the same plane. The knees, therefore, project in different directions, and this increases the chances of one of the pollinia being inserted into the stigmatic chamber. There is nothing to render it probable that the bee's proboscis will be introduced in the same relative position, and so there is no advantage in both of the knees, or either of them, turning to the same side. In *Asclepias* and *Acerates*, in which the corpuscula are usually attached to short hairs on the legs, or other parts of the body, as in *Acerates longifolia*,[5] it is important that the knees should turn away from the part to which they are attached, for this is the only side on which they are likely to be caught by the anther wings. In large flowers, like *Asclepias Sullivantii*, in which the corpuscula are attached to the bee's claws, the bees commonly clasp the flowers so that the legs are guided upwards between the hoods. The movement of the knees which brings them near together results in turning them inwards, in which position they are more likely to be brought to the stigma. In *Enslenia* the corpuscula are attached so near to the end of the proboscis that there does not seem to be any advantage in turning in any particular direction, though they are slightly turned towards the side on which the corpusculum is attached.

Müller and Corry erroneously supposed that the movement

[5] Bot. Gaz. **12**: 245. 1887.

of the pollinia of *Asclepias*, which approximates them, is intended to facilitate the introduction of both pollinia into the same stigmatic chamber. In *Cynanchum vincetoxicum*,[6] whose mechanism in a general way resembles that of *Enslenia*, Müller states that the retinacula bend so that the pollinia come close together. The flowers are adapted to carrion flies, Muscidæ, Sarcophagidæ, etc., and I suspect that the movement is merely to turn the knees away from the proboscis. Müller's account of the pollination of *Cynanchum* seems to me to be just as erroneous as that of *Asclepias Cornuti*. In the normal pollination of any asclepiad I doubt if it can be shown either that the part to which the corpusculum is attached is again caught by the wings, that the corpusculum ever enters the slit, or that both pollinia together are ever introduced into the same stigmatic chamber.

The flowers of *Enslenia* are visited principally by bees of the genus *Halictus*. These insects readily remove the corpuscula, which are found attached to the palpi, the tips of the laminæ, or other fine divisions of the proboscis. *Myzine sexcincta* was abundant on the flowers, but I could find no examples bearing corpuscula. The following list was taken on July 14th, 20th, and August 22d; the insects bearing corpuscula are indicated by !

Hymenoptera—*Andrenidæ:* (1) Prosopis pygmaea Cr. ♂; (2) P. modestus Say ♀, !; (3) Halictus confusus Sm. ♂♀, ab., !; (4) H. zephyrus Sm. ♂♀, ab., !; (5) H. stultus Cr. ♂♀, ab., !; (6) H. tegularis Rob. ♂♀, !; (7) H. cephalicus Rob. ♀; (8) H. platyparius Rob. ♀; (9) Augochlora viridula Sm. ♂♀; *Eumenidæ:* (10) Odynerus sp.; *Scoliidæ:* (11) Myzine sexcincta F., ab.

Diptera—*Empidæ:* (12) Empis clausa Rob. MS; *Bombylidæ:* (13) Anthrax fulvohirta Wd., !

Carlinville, Ills.

[6] Müller, Alpenblumen, 350. Fertilization of Flowers, 401.

Noteworthy anatomical and physiological researches.

Anatomy of Vellozieae.[1]

The *Vellozieae*, a tribe of *Amaryllidaceae*, are known from South America and Africa, but have their largest distribution in Brazil. Only two genera, *Vellozia* and *Barbacenia*, constitute the tribe, and these are all perennial, with erect stems, branching dichotomously. The leaves are long, erect and linear, more or less carinate, are provided with large sheaths, and form fascicles at the upper part of the branches. The height of certain species averages two meters. The most characteristic feature, however, is the thick coating of roots in *Vellozia*, which develop from the stem and proceed within the leaf-sheaths towards the ground. The roots are thus only visible at the base of the trunk, when the old sheaths have faded away.

A transverse section of the trunk of *Vellozia* is round and shows a few relatively thin and triangular branches, surrounded by a huge mass of roots. The anatomical structure of these roots is identical with that of a normal monocotyledonous root, but the vessels are often filled with a brown or yellow substance, probably a kind of resin, especially abundant in *Vellozia*. The central part of the root is occupied by a heavy layer of exceedingly thick walled stereome. The endodermis is thin walled, sometimes starch bearing. The inner bark has an open, loose structure, and is surrounded by the outer bark, which is here composed of a cylindric layer of stereomatic tissue.

Outside these tissues is a hypoderm of a single stratum of thin-walled cells and finally the epidermis, which sometimes develops root-hairs. The hypoderm is stained blue by iodine and sulphuric acid.

The peculiar feature of the roots extending along the stem within the leaf-sheaths seems to be common in the genus *Vellozia*, but is as yet unknown in *Barbacenia*. The function of this fibrous coat of roots seems to be to gather moisture from fogs and rains. This explanation is the more evidently correct when we consider the localities in which the

[1] WARMING, Eug. Note sur la biologie et l'anatomie de la feuille des Vellosiacées. (Extrait du Bull. l'Acad. roy. d. Sc. Copenhague 1893).

plants grow. They are largely inhabitants of stony, sunny places with but little earth for the penetration of their roots. They are, therefore, protected against excessive drought by a fibrous coating, consisting not only of the roots but also of the remaining fibers of the leaf-sheaths. The author has observed that this fibrous coat absorbs water very rapidly and in large quantities. It is also probable that the erect and more or less carinate leaves serve the same purpose, viz., for a centripetal absorption of water. The stem is thus protected against excessive evaporation rather than against the frequent fires of the campos.

The structure of the leaf shows several peculiarities. The author has studied this especially from sections of the median portion of the blade, since it was observed that there exist certain differences between the structure of the basal and the median portion of the same blade. *Vellozia compacta*, for instance, shows at the leaf-base a tissue which reminds one very much of the thin-walled, transparent tissue so characteristic of Gramineæ, Cyperaceæ, Juncaceæ, etc., while this tissue was not observed higher up on the same leaf.

The subepidermal tissue of the blade shows above the carene a development corresponding to the bulliform cells described by Duval Jouve for several monocotyledonous families. These cells have undoubtedly the same mechanical function in the Velloziеæ as in those families, serving for involution of the blade in a dry atmosphere. The stomata are arranged in longitudinal rows. *Vellozia* has a distinct palisade-tissue, which is almost lacking in *Barbacenia*, and the structure thus becomes nearly isolateral. In the genus *Barbacenia* certain cells of the mesophyll were observed to contain water. Similar water-storing cells were also observed in *Vellozia*, but in this case they belonged to the hypoderm.

There is a certain distinction between the development of the various tissues of the leaf not only within these genera, but also within their species. These differences appear to the author to be of value in the anatomical characterization of the species of the tribe. THEO. HOLM.

Ombrophilous and ombrophobic organs of plants.[1]

Although this treatise on the adaptation of plants to extreme amounts of rain is only preliminary, it nevertheless

[1] J. WIESNER: Ueber ombrophile und ombrophobe Pflanzenorgane. Sitzungsberichte d. kais. Akad. d. Wissensch. Wien. **102:** —. 1893.

contains results of great interest and valuable suggestions for further investigations. It was a problem the author undertook to investigate in the moist climate of Java, but in order to prepare himself for this, he made some experiments in Austria and the results are recorded in the present paper. The relation between leaf-shape and rain-fall in tropical regions, where moisture and heat prevail, has already been studied by Stahl, Jungner and others. But the direct mechanical effect of rain upon the plants and the power of resistance possessed by them against this factor has so far not been taken into consideration.

It is well-known to cultivators that many plants are only able to thrive when they obtain a certain amount of water, and that several species die if they get too much. The full-grown leaves of the potato-plant decay and young leaves on autumnal shoots of certain trees are destroyed, when exposed to excessive rain-fall. We know, however, from amphibious plants, that there is a great difference in regard to the ability of plants to withstand the effects of water. We have, also, learned by water-cultures that the roots of terrestrial plants thrive in water, while the aerial parts of these same plants die when they become submersed. In order to test this varying power of resistance against water, the author made the following experiments:

Shoots cut from various plants were placed upon a sieve and continuously sprinkled with artificial rain day and night, the temperature of the water being between 16 and 20° C. The power of resistance of these plants was shown by this experiment to be very different. The shoots of Solanum tuberosum decayed within a few days, while those of Lysimachia Nummularia and Tradescantia zebrina kept fresh for four weeks, and some hot-house Selaginellæ were healthy even after an exposure to eight weeks steady rain. It was observed during the same experiment that the youngest leaves decayed first and then the oldest, while those which were in their greatest vigor were the last ones to decay. Solanum tuberosum was an exception, the very youngest leaves showing the greatest power of resistance. A similar result was obtained by submersing shoots in basins where a constant current of water was flowing. Shoots of the same plants died much sooner if they were submersed in stagnant water. There was also observed to be a great difference in regard to

the time of decay, when the experiments were made in daylight and in a dark room. The decay set in much earlier in the dark, evidently due to the fact that many bacteria are arrested in their development and propagation when exposed to light.

It appears from these experiments that the best way to form a correct judgment regarding the resistance of plant-organs against the influence of water is to keep them in stagnant water. In these experiments the full-grown leaves were the first to lose their turgescence. They became soft and soon decayed. Fresh shoots of Lysimachia Nummularia were placed in the decayed liquid resulting from this experiment, and they kept fresh for fourteen days. Pieces of marchantia thallus lived about eight days.

Another kind of experiment was made with potted plants. These were exposed to continuous rain, but in such a way that the water was prevented from saturating the earth. A plant of Phaseolus multiflorus, 80^{cm} in height, died entirely after thirty-two days, Tradescantia zebrina after forty-five, while T. guyanensis on the contrary was still healthy after sixty-two days.

The same was the case with Begonia magnifica and various hot-house Selaginellæ. These results show that various plants possess an unequal power of resistance against a continuous rain and the presence of water. The author believes himself justified in distinguishing two categories of plant-organs: the "ombrophilous," or such as love or rather tolerate the rain; the "ombrophobic," which dread the rain. These terms are, of course, only to be applied to organs above ground. The underground roots are evidently always hydrophilous, even in plants which have ombrophobic foliage, as for instance Impatiens noli-tangere.

We might now at the first glance think that these two categories of organs belong to plants which are limited to distinct localities, say to dry or moist places, and that the ombrophilous foliage should characterize the hygrophytes and the ombrophobic the xerophytes. But this conclusion is not a valid one since there are some plants whose foliage is ombrophobic, and yet which can not be considered as xerophytes, as for instance Solanum tuberosum. So too there are hygrophytes which are decidedly ombrophobic, like Impatiens noli-tangere.

Impatiens grows in moist and shaded places and requires a large supply of water for its existence. But the leaves of this plant do not get wet by rain, and it, therefore, obtains the necessary amount of water exclusively through the roots. In contrast to Impatiens is Sanicula Europæa from similar situations. This is decidedly ombrophilous, and the leaves become easily wetted by rain. This fact was also proved by submerging leaves of both plants in stagnant water, where those of Impatiens decayed in three days, and those of Sanicula only after eleven days.

The xerophytes are, according to the author's experience, often ombrophobic in a greater or less degree. It would appear that those with rather dry leaves do not withstand the effects of rain as those with thick succulent leaves, as for instance sempervivum and echeveria. The hygrophytes contain, as already mentioned, representatives with foliage of both categories, although the majority are very likely ombrophilous, but those with ombrophobic foliage are protected not only by the locality (shaded places) but also, and quite especially, by the waxy covering of their foliage.

The aquatics are hydrophilous as are also the underground roots, which are constantly exposed to the influence of water.

Another question arises as to the power of plants to resist the injurious effect of an excess of water, by which they might become thoroughly soaked. We have here to do with a mechanical and chemical power of resistance. The mechanical power may be in the "bloom" that covers the leaves of many plants, and which prevents them from being wetted unless exposed to an excessive rainfall. But those leaves that while easily wetted by rain are still able to preserve their vitality must possess a purely chemical power. The author believes this to consist in the presence of antiseptic substances. He has shown by experiments that ombrophilous shoots of Lysimachia Nummularia, Selaginella spp., begonia, tradescantia, etc., are able to keep fresh for a long time in a decayed liquid. He has, also, observed that the presence of such ombrophilous organs delays the decomposition of ombrophobic organs, when exposed together to a continuous shower of water. It would appear therefore that ombrophobic foliage is protected in a purely mechanical way, while the ombrophilous is protected by the presence of antiseptic substances.

THEO. HOLM.

BRIEFER ARTICLES.

Relationship of Cæoma nitens and Puccinia Peckiana.—*Cæoma interstitiale* Schl., or as it is better known, *Cæoma nitens* Schw., has been regarded by different botanists as the probable æcidio-stage of several species of Uredineæ. Dr. Burrill was the first to suggest that it might be an earlier stage of *Puccinia Peckiana* Howe. It was from this suggestion that during the past three years a careful study of these two forms was made, the results being published in bulletin no. 29 of the Illinois Agricultural Experiment Station. Although not successful in a preliminary attempt to produce the Puccinia from the Caeoma by artificial infection, there was sufficient evidence gathered to conclude that the two were only stages of one fungus. After having written this bulletin, but before publication, an article by Tranzschel[1] was received, in which he gave an account of a successful experiment where he produced *Puccinia Peckiana* by sowing spores of *Cæoma nitens* on young shoots of *Rubus saxatilis*.

Last spring infetion experiments were again undertaken by myself with more satisfactory results. Early in the winter underground parts of *Rubus villosus* and *Rubus occidentalis* were removed from the University forest and placed in crocks in the greenhouse. These plants had not been affected the preceeding summer by either the Caeoma or the Puccinia. In the spring the plants started to grow fairly well, and are yet alive. On June 9th fresh spores of Caeoma nitens were placed on the young leaves of both a blackberry and a raspberry, and on June 14th two more raspberries and another blackberry were likewise treated. In each case spores from a corresponding plant were used, save in one of the latter raspberries where spores from a blackberry were used. Besides the foregoing plants several were kept free from spores to serve as checks. On July 26th, forty-seven days after sowing spores, mature sori of Puccinia Peckiana were found on one of the blackberries, and a few days later, on the other also. In Tranzschel's experiment but twenty-four days intervened between the sowing of spores and the finding of teleuto-sori. The infection while not abundant was quite apparent on several leaves. No sori appeared on the three test raspberries or on the checks. As raspberries are much better protected by hairs on the lower surface of their leaves, infection of such plants is no doubt much harder to accomplish than that of the blackberry. The time between sowing and apparent

[1] Hedwigia **32**: 257. 1893.

infection, six or seven weeks, coincides quite well with the time that elapses between the first appearance of the Caeoma and that of the Puccinia out of doors. As these experiments were carefully conducted there seems no doubt that these forms are related. Experiments producing the Caeoma from the Puccinia would be much more difficult, as infection in this case no doubt takes place through the very young basal shoots.

The connecting of these forms brings up an interesting point of nomenclature. In the bulletin referred to I accepted *Puccinia Peckiana* Howe as the name of the fungus, while Tranzschel re-named it *Puccinia interstitiale* (Schl.) Tranz. The question is merely whether the rule of priority shall apply to the very first name given or whether to the first name given to the mature form. The latter method seems to me the much more rational as it does away with needless confusion and increase of synonyms. As a matter of curiosity on this point, I submitted the data to five of the best botanists of this country, four of whom have favored me with their opinions. All stated that it was a mootable question, but one that should be settled. Two were inclined to believe that, as now interpreted, priority would be carried to the first name given to any stage, while two decided that the priority rule should apply to the first name given to the mature form.—G. P. Clinton, *University of Illinois.*

Some field notes.—While searching for some fungi on *Ulmus Americana* leaves, two were found on a young tree which present a strange and interesting departure. The petiole, one-third of an inch above where it becomes a midrib, bifurcates so as to make an angle of about fifty degrees between the two subdivisions. Each of the subdivisions becomes a midrib to a leaf whose outer edge is normal, and the inner edge is also normal down to about an half or two-thirds of an inch above the bifurcation. Here the two leaflets join together, making a compound leaf.

In laboratory pressed specimens of *Viburnum acerifolium* a superficial observer will be mystified by apparent petioles that bifurcate and at each end of the bifurcations will be found a normal leaf. Careful observation will prove the apparently bifurcated petiole to be a stem with a terminal bud, and in the axil of last year's fallen leaf. The terminal bud is best made out from fruiting specimens.

In 1889 while botanizing in the mountains near Elliston, Montana, I passed a low specimen of *Acer glabrum*, whose appearance was such as to strike one as strange, and yet as *Acer glabrum* is the only Acer I had found in eight years of Montana work, I passed it by; after going several rods, its curious, indescribable appearance caused me to

return and make a closer examination, when I was astonished to find its peculiar appearance was caused by *dissected* leaves! Every leaf on the whole shrub was dissected. I call it a shrub, for in the mountains, *Acer glabrum* is hardly worthy of any other name. The dissection was such as to make the compound leaf trifoliate palmate.

A young student in Oberlin college, a practical and intelligent farmer, has brought me two carrots which have grown together in a peculiar manner. The leaves were gone, but he testifies emphatically that both component parts are carrots. One is flesh color and the other white. They crossed each other near their tops, grew together at the point of intersection in such a manner that the red bottom had a white top, and the white bottom a red top. Longitudinal section showed that the vascular systems had also grafted into each other so that the chief sustenance of the white top came from the red bottom, and *vice versa*. The original connections of red to red, and white to white were kept up, but in an evidently great reduction. The outer appearance was like Siamese twins, but the longitudinal section showed it to be a case of grafting and adoption.—F. D. KELSEY, *Oberlin College, Oberlin, O.*

EDITORIAL.

IT IS REALLY a serious question how properly to make that combination known as a "biological course," a course which is becoming more and more common as an introduction to both botany and zoology. We might as well state in the outset that we do not believe in it, any more than in a common introductory course for chemistry and physics, but this has nothing to do with the present writing. Having a prevalent custom, however, the question is how to make the best of it. In the first place, we decidedly object to the continued appearance of combination laboratory guides prepared by zoologists. If botanists had the temerity to produce such books we should make the same objection. The very best of these "biological guides" lies before us, a book admirable in its spirit and in its presentation of late views, but a botanist must be well trained to keep from losing his way in the midst of the zoological terminology and atmosphere; and when the phanerogams are reached, the book breaks down entirely, and the *denouèment* of the botanical story is omitted. While it may be very desirable to have a uniform terminology for plant and animal morphology, the fact remains that we do not yet possess it, and such "combination guides" introduce students to botanical literature with an uncertain and confused terminology, to say nothing of a dubious morphology. When at the last meeting of the "American Morphological Society," which, by the way, means animal morphologists, one of its most distinguished representatives presented a paper on a "Fundamental difference between animals and plants," which consisted in the fact that "animals feed typically upon solids, and plants always procure their food in a gaseous or liquid form," the idea is emphasized that there is need of a botanist when plants are being discussed.

In the second place, even if the book which treats of zoological botany be discarded, we also object to such a course being conducted by a zoologist. We should make the same objection were botanists inclined to undertake it. Any laboratory guide is useful to the student only in so far as the author has been over the ground himself and has kept abreast with the advance in knowledge. If botanical researches to-day were dealing only with the etceteras of botanical doctrine, it might be true that a zoologist could take time enough to make himself sufficiently proficient to present the fundamentals of botany. But the fact is that the researches of to-day are attacking the foundations, and the very body of botanical doctrine is being rapidly modified.

CURRENT LITERATURE.

A life of Rafinesque.

The Filson Club of Louisville has published in sumptuous form[1] an account of the life and writings of Rafinesque, prepared by Dr. R. Ellsworth Call. This Club is devoted to the history of Kentucky, and its interest in Rafinesque arises from the fact that he was the first "resident professor-naturalist" in the state. Dr. Call is a student of our fresh-water shells, especially the *Unionidæ*, and the devious trail of synonymy led him into the papers of Rafinesque, with the publication of the present memoir as a result. The figure presented to us has always been a picturesque one in the annals of American science, whose work and character have always been a puzzle, possibly because too little is known of either. The BOTANICAL GAZETTE (8: 149) once published a sketch of him, in a series of early botanists, but it was merely a compilation of current opinions, and while recognizing his ability did scant justice to his work and spirit. Dr. Call has done well with the material at his command, and seems to have spared no pains in collecting and verifying it. The current notion as to the personality of Rafinesque has been largely drawn, doubtless, from the caricature for which Audubon was responsible. We are very glad to have this corrected by letters, published here for the first time, of persons who had personal relations with Rafinesque as students or friends. He stands forth as eccentric in every testimony, but not as the bedraggled figure in yellow nankeen, with neglected hair and beard, that has been our only description. "Small and slender, with delicate and refined hands and small feet; good features and handsome dark eyes, with long hair, dark and silky; going into society, and a good dancer," is the description of one who knew him while a professor at Transylvania University, Lexington, Ky. Other descriptions accord with this, and add touches which go to show that Rafinesque, although a very absorbed and absent-minded man, was a gentleman in appearance and deportment.

The explanation of his wide and restless roving through almost every department of human activity, culminating as it did in the monomania of his later years, is offered in his early lack of any master to guide him and to direct his impetuous genius into habits of concen-

[1] CALL, RICHARD ELLSWORTH.—The life and writings of Rafinesque: Filson Club Publications No. 10. 4to pp. 227, with two portraits and certain reproduced pages. John P. Morton & Co., Louisville, Ky. 1895. $2.50.

tration, and in his many misfortunes. With no training, no contact with scientific men, and a mind wonderfully self-opinionated, his career is not to be wondered at. He surely was the personification of honesty, and the scientific blunders into which he was led were due either to his implicit confidence in the representations of others, or his exaggerated notions as to the importance of minor variations. When one looks at the bibliography that has been so carefully worked out by Dr. Call, and sees no less than 420 titles, he wonders at the prodigious activity that was possible under so many disadvantages. Opinions as to the value of Rafinesque's work will always differ, but he is none the less a most interesting figure, and, with all his excursions into other fields, was first and foremost a botanist.

Minor Notices.

CONTRIBUTION No. 9, from the U. S. National Herbarium, completes the first volume of this series, and is a report by the assistant botanist, Dr. J. N. Rose, upon a collection of plants made in Sonora and Colima in 1890 and 1891, by Dr. Edward Palmer. The report has been long delayed in publication, and it shows what was expected from such a region as Mexico, and such a collector as Dr. Palmer. As the collections of Pringle, Palmer and others increase in number we begin to appreciate the vast and varied flora which lies just to the south of us, a flora which we will presently have to include in our North American treatises. In the present instance Dr. Rose has wisely sought the aid of recent specialists in various more critical groups. In addition to some very useful illustrations printed in the text, such as leaves, pods, etc., there are twelve Meisel plates, besides the frontispiece. Seventy new species are described, but many other numbers are described without names, a practice which has no advantage and serves to make trouble in reference lists. One must keep track of these described and unnamed forms, but there is nothing by which to distinguish them and they are easily lost sight of. The report is a valuable contribution to our knowledge of the Mexican flora, and contains no less than sixty additions to Hemsley's list, besides the seventy new species.

A CONTRIBUTION to our literature of Arctic plants has just been distributed as a separate from Engler's Bot. Jahrb. 19: 4. 1894. It consists of two papers by Dr. F. Kurtz, one dealing with the flora of the Chilcat region in S. E. Alaska, the other with the region of the "Tchuktchies," a people inhabiting the easternmost peninsula of Siberia opposite Alaska. The collections were made by the Krause

brothers in 1882, upon an expedition made under the auspices of the Bremen Geographical Society. The paper contains a description of the regions, and discusses zones of vegetation, trees and shrubs, food-giving plants, introduced species, and local plant names. The lists of plants are full, and evidently fairly representative, accompanied by critical notes. To the American botanist it would be evident at once that Dr. Kurtz has not had access to the more recent monographs published in this country.

A NEAT SOUVENIR[1] of a botanizing trip in the vicinity of Black Barren Mineral Springs, Lancaster co., Pa., has been issued primarily for distribution among friends of the writer. Only the common flowers are mentioned, and their mostly prosaic names rather detract than add to the slight poetical effulgence of the measured lines and rhymes. As a souvenir it is neat and attractive; as poetry it does not strongly impress the unbiased reader.

THE EXCELLENT SERIES of illustrated articles by Dr. W. G. Farlow in *Garden and Forest*, under the heading: "Notes for mushroom-eaters," have been republished in pamphlet form. It makes a convenient popular account of the best and most common edible fungi.

A HANDY ANALYTICAL KEY to the suborders, families and genera of N. A. Pyrenomycetes, recently distributed by Mr. J. B. Ellis, furnishes a much needed assistance in using Ellis and Everhart's work on these plants.

THE PAPER on electricity in plant-growing, by Prof. L. H. Bailey, read before the Massachusetts Horticultural Society, has been distributed as a separate pamphlet.

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[1] S. M. H. The golden rod and other flowers. 12mo. Geo. W. Richards & Co., Philadelphia, 1894. pp. 20. 25cts.

NOTES AND NEWS.

CAPTAIN JOHN DONNELL SMITH has gone to Europe, for an absence of three months, in connection with his work on the Central American flora.

DR. GEO. A. REX, the leading student of Myxomycetes in this country, died recently at his home in Philadelphia. We have received no particulars.

MR. M. S. BEBB has been compelled again to go to Florida to spend the winter on account of his health. He carries with him some "willow work" and also our best wishes.

THE CURRENT CATALOGUE of Harvard University reports the herbarium as containing more than 200,000 sheets, and the botanical library over 9,000 volumes and pamphlets.

DR. W. J. BEAL has published in full his "Sugar maples of Central Michigan," read at the A. A. A. S. last summer, in the annual report of the Mich. State Board of Agriculture, vol. 33.

IN THE *J. H. U. Circular* for January (14: 25) is an account of "some rare ferns found near Baltimore," by Mr. C. E. Waters, in which is described a new variety of *Equisetum arvense* L.

M. A. FRANCHET, in continuation of his studies of the plants of Western China, publishes in *Journal de Botanique* (Nov.) four more new species of *Saussurea*, and eighteen new species of *Senecio*, twelve of which are of the Cacalia group.

IN A RECENT PAPER (Proc. Amer. Acad. 1894: 396) on variability in the spores of *Uredo Polypodii* (Pers.) DC., Mr. B. M. Duggar shows that the thick walled and thin walled spores simply represent different stages of maturity, the latter being the immature form.

IN MR. J. W. TOUMEY'S very interesting series of notes on the flora of the Chiricahua Mountains (Arizona), appearing in *Garden and Forest*, the second installment (Jan. 16) is accompanied by two beautiful photographic reproductions of Pinus Chihuahuana, and P. latifolia, standing in the midst of their native topography.

THE COMMITTEE of Section G, A. A. A. S. on Bibliography of American botany recommend that persons recording in a monograph or memoir a list of papers consulted repeat the author's name with each article listed, for the convenience of any who may wish to cut up the pages and make cards (either electros or prints).

PARTS 109 AND 110 of *Die natürlichen Pflanzenfamilien* are devoted to the Bignoniaceæ by K. Schumann, and the Mucorineæ, Entomophthorineæ, Hemiascineæ, Protoascineæ, Protodiscineæ, Helvellineæ, Pezizineæ, by J. Schröter. The rapidity with which this great work is appearing is a matter of congratulation to all botanists.

MR. MERRITT LYNDON FERNALD, of the Gray Herbarium, Cambridge, Mass., proposes to continue his distribution of Maine plants during the coming season. Sets will be collected to continue the series started in 1893. Collections will be made chiefly in central and southern Penobscot and Piscataquis counties, which contain hundreds of lakes, and the highest mountains of Maine.

AMONG VARIOUS notes upon *Labiatæ*, published in *Bull. l'Herb. Boissier* (Dec.), M. John Briquet describes some new forms of *Mentha*. The great amount of variation of some of the species is shown by the fact that of the new forms described ten are varieties of *M. rotundifolia*, twenty-one of *M. longifolia*, nine of *M. arvensis*, six of *M. viridis*, five of *M. piperita*, and in the whole list of sixty-five new forms but eleven species are concerned.

USTILAGO MEDIANS is a new parasitic fungus occurring on barley, discovered by Herm. Biedenkopf in the neighborhood of Halle, Germany. In external characteristics, this species resembles *U. Hordei*, between which and *U. Jensenii* it occupies an intermediate position. A partial description of this fungus appears in Zeitschrift für Pflanzenkrankheiten 4: 321. 1894. A complete description will appear as soon as the species is thoroughly studied.—L. S. C.

IN THE December number of *Forstlichnaturwissenschaftliche Zeitschrift*, "Investigation of the morphology and anatomy of malformation upon shoots and leaves caused by the Exoasci," by W. G. Smith, is finished, and Dr. Robert Hartig has another paper on the investigations of wood entitled, "Investigations on the course of growth in oak in the Guttenberg and Grauschatz forests near Würzburg, and in the forest district Freising and Starnberg, near Munich."—L. S. C.

FASCICULUS I of a distribution of Russian fungi under the title *Jaczewski, Komarov, Tranzschel, Fungi Rossiæ Exsiccati* has just appeared. It contains 50 specimens with printed labels, mounted on quarto sheets, after the manner of Thuemen's Mycotheca. Among the Uredineæ are such interesting specimens as *Puccinia Fergussoni* Berk. et Br., *Puccinia Eremuri* W. Kom., *Puccinia Rosæ* Barclay, *Puccinia plicata* W. Kom., *Phragmidium devastator* Sorokin, *Phragmidium circumvallatum* P. Magnus.—E. W. D. H.

MR. M. C. COOKE publishes in *Gardeners' Chronicle* (Dec. 22) an account of blindness caused by eating the fruit of a Rhodomyrtus in Queensland (Australia). The fruit has the botanical reputation of being not unwholesome and Mr. Cooke discovers that the probable cause of this singular effect is the presence of a Gloeosporium, which he describes as new. As this genus attacks many fruits it will be of interest to follow up this suggestion.

In *Hedwigia* (33: 307–337. 1894) C. Warnstorf gives a complete descriptive synopsis of all North, Central and South American species of *Sphagnum*, with the geographical distribution of each. He recognizes 15 N. Am. species of §I. ACUTIFOLIA; 2 of §II. SQUARROSA; 10 of §III. CUSPIDATA; 1 of §IV. POLCLADA; 3 of §V. RIGIDA; 14 of §VI. SUBSECUNDA; and 7 of §VII. CYMYIFOLIA; 52 species in all. Twenty-five species are found in South America only (on this continent) and

7 in Central America. Only 5 species are known from Europe not found also in America.

MR. BRADLEY M. DAVIS, in *Annals of Botany* (Dec.), describes, with colored plate, a new and very interesting alga-like organism, to which he gives the generic name *Euglenopsis*, from a certain resemblance to Euglena. It was found in the salt marshes near Cambridge, Mass., clinging to marsh grass and other objects on or near the surface of the water. Although not readily apparent why this organism should be considered a plant rather than an animal, Mr. Davis remarks its close affinities to certain genera usually considered as plants, and so feels justified in presenting the paper to botanists.

THE CAMBRIDGE BOTANICAL SUPPLY COMPANY, 1284 Massachusetts Ave., Cambridge, Mass., wishes early correspondence with any who are interested in an edition of the Bibliography of American Botany on cards of their own choosing, any special size or kind; an edition by subjects; an edition from which cards may be selected on special topics. The Company is also considering a plan for searching botanical literature and reporting to subscribers references on any special topic. This would be of great service to those who live out of reach of great botanical libraries and we hope help of this kind may be made available.

AT A SPECIAL meeting of the Council of the A. A. A. S., held on January 26th, it was decided to postpone the proposed meeting in San Francisco. An invitation from Springfield, Mass., to hold the meeting of 1895 in that city, was accepted. The date of the meeting was fixed as follows: Council meeting, Wednesday, August 28th, at noon; general sessions, Thursday, August 29th, at 10 A. M. Special efforts will be made by the officers of the sections to prepare programs for the sections in advance of the meeting and for this purpose members are requested to send abstracts of their papers, as early as possible, to the Permanent Secretary, or to the Secretaries of the Sections.

BOTANY at the German universities is described by Dr. George J. Peirce in *Educational Review* (Jan.). The American college for general elementary training, and the German university for training as an investigator, seems to be the approved combination. "The logically related courses in botany at our best colleges furnish a better preparation for subsequent investigation than the unarranged courses at the German universities, but in Germany the professors are able, because they are not overburdened with elementary work, to give much attention to their own researches and to the investigators under them."

MACMILLAN & Co. announce a translation of the new Strasburger, Noll, Schenck, and Schimper *Lehrbuch der Botanik*. The completeness with which the whole subject of botanical study is treated and the reputation of the authors make the announcement of this book one of unusual importance. The illustrations, some 570 in number, have been made a special feature of the book, and by arrangement with the German publishers, Macmillan & Co. are enabled to offer illustrations of the same degree of excellence as those in the German edition. The translation will be made by Dr. A. C. Porter, assistant

instructor in botany, University of Pennsylvania. Dr. Porter has been a student of Strasburger, and his long studies in Germany and personal acquaintance with all the authors of the book render him especially fitted for the work.

MR. D. M. MOTTIER has published in *Annals of Botany* (Dec.) an account of his study of the life history of Notothylas, N. orbicularis being the species used. His conclusions are: (1) the capsules possess a columella varying in size with that of the capsule; (2) the columella originates, as in Anthoceros, primarily in the young sporogonium with the archesporium, and independently of it, and consequently it is not a secondary differentiation within the spore-chamber; (3) the archegonium resembles more closely that of the eusporangiate ferns than does the archegonium of Anthoceros; (4) the antheridium arises from a hypodermal cell, a process occurring nowhere else in the whole group of bryophytes.

MESSRS. FRANK S. COLLINS, ISAAC HOLDEN, and W. A. SETCHELL announce the issue of a series of fascicles of North American algæ under the title *Phycotheca Boreali-Americana.* The fascicles will be in book form, containing fifty species each. Two fascicles will be issued this winter, of which the first has already appeared, and two or more a year will be distributed hereafter. The work will include all families of algæ, both fresh water and marine, except that no provision has yet been made for diatoms, desmids or charads; they may, however, be included later. In geographical range it will cover North America entire, from the Arctic Ocean to the Isthmus of Panama, and will include the West Indies. The edition is limited to eighty copies and subscriptions will be taken only for the series, which should find ready sale. All correspondence on the subject should be addressed to Frank S. Collins, 97 Dexter St., Malden, Mass., U. S. A.

THE *Bulletin Torr. Bot. Club* for January is devoted to taxonomy as follows: Mr. J. H. Barnhart presents an extended paper on "family nomenclature," in which the laws of priority that have been adopted for genera and species are applied, the uniform termination *aceæ* appended to the name of a recognized genus is urged, and certain limitations as to priority suggested, a list of the family names of phanerogams constructed in accordance with these suggestions being given, with full synonymy; Miss Anna Murray Vail gives a revision of the North American species of the genus *Cracca* (Tephrosia), fourteen in number, one of which is proposed as new; Mrs. Britton revises *Scouleria* and describes a new species (with plate); Mr. John K. Small continues his studies of the flora of the S. E. United States, describing three new species (Juncus, Monniera, and Coreopsis); and Mr. L. F. Henderson describes two new plants from Idaho (Phacelia and Claytonia).

PROFESSOR E. L. GREENE has given an interesting historical account of *Mimulus luteus* in the *Journal of Botany* (Jan.). It seems that the original M. luteus is a South American plant, and that it was unknown for a long time except through its description and figure. In the meantime a yellow Mimulus from North America came into notice, which by some botanists was regarded as identical with the South

American plant, by more as a distinct species, being described by DeCandolle as *M. guttatus*. In Bentham's revision of the order for the Prodromus, however, both forms were referred to M. luteus, and in the Synoptical Flora this same reference was retained by Dr. Gray, several other North American forms also being included in it, but which were set apart later in the Supplement as distinct. Professor Greene finds the North and South American plants sufficiently distinct, and also discovers that *M. Lansgdorfii* Don is the oldest name for the North American plant. The name M. luteus, therefore disappears from our flora, and M. Langsdorfii remains as the name of the somewhat polymorphous aggregate.

Mr. J. C. Willis published his third paper on "gynodiœcism" in *Proc. Cambridge* (England) *Phil. Soc.*, Nov. 1893, a paper which has just come to our hands. His further experiments indicate that the strong tendency to gynodiœcism and gynomonœcism shown by many plants, notably the Labiatæ, seems to be a natural outcome of dichogamy, and has to do with differences of nutrition. He considers that diœcism in angiosperms is descended from hermaphroditism, and "that the sex of a seedling can to some extent be determined in advance by its conditions of nutrition." Androdiœcism is found to be very rare, and seems to be certainly due to lack of nourishment of the "male plant." Cleistogamy is found to be sporadic in some plants, constant in others, varying with all sorts of external conditions. It is noteworthy that cleistogamy does not usually occur in plants that are dichogamous, or in gynodiœcious genera (excepting Salvia). The experiments are very interesting, but it might be well to express the hope that in view of our present knowledge of morphology the constant use of sex terms in connection with sporophytic structures will be abandoned.

The *Annals of Botany* for December might be styled an American number, as four of the six papers are by American botanists. The papers of Bradley M. Davis and D. M. Mottier are noticed elsewhere in this journal. In addition to these F. C. Newcombe writes concerning the cause and conditions of lysigenous cavity-formation, and V. M. Spalding on the traumatropic curvature of roots. Mr. Newcombe finds that the appearance of the cavity during primary growth or subsequently depends upon the retardation of extension in the tissues concerned relative to extension of more peripheral tissues; that the initial cavity-formation in primary growth is always schizogenous, and that there are always two factors concerned in cavity-formation, a schizogenous and a lysigenous; that cavity-formation during primary or secondary growth may occur in different individuals of the same species, dependent upon peripheral extension as stated above; and that the formation of a cavity during primary and secondary growth may be greatly deferred by preventing peripheral extension. Professor Spalding, in experimenting upon those phenomena following wounds to which the term traumatropism has been given, seeks to gain some definite information as to whether the phenomena are to be classed as mechanical or irritable movements. His conclusions are that the growing point of the root is sensitive, that induction follows irritation, and that traumatropic curvature is the result. All the facts in the case that have been recorded by other observers are shown to be consistent with this explanation.

THE DISENTANGLEMENT of *Quercus Texana* Buckley, by Dr. C. S. Sargent, is recorded in *Garden and Forest* (Dec. 26). Described first in the Mexican Boundary survey as a variety of *Q. coccinea*, then set apart as a species by Buckley, it was finally referred by Dr. Engelmann to *Q. rubra* as a variety, and then lost its identity completely in later writings as *Q. palustris*. At the same time a puzzling oak was known from near St. Louis and the Lower Wabash Valley, which seemed more nearly like *Q. palustris* than anything else. During a recent visit to the Lower Wabash Valley in connection with Dr. J. Schneck, Dr. Sargent recognized the form and then traced it on southwards into Texas. It seems, therefore, that *Q. Texana* is a very widely distributed oak, its range, as at present made out, extending from Minnesota, in the neighborhood of Minneapolis and St. Paul, southward through Iowa, Illinois, Indiana and Missouri, in which northern extension it is associated and confused with *Q. palustris*, and thence further southward to the Gulf, extending from Florida to Texas, and in this southern range all that has been called *Q. palustris* proves to be *Q. Texana*. In the absence of nuts the tree cannot well be distinguished from *Q. palustris*, but the nuts are more nearly those of *Q. rubra*. The bark and winter buds and leaves resemble those of *Q. coccinea*, but the leaves have the axillary tufts of hairs so characteristic of those of *palustris*, a fact which doubtless explains the constant reference to that species. It would be well for botanists to look into the oaks of their vicinity and of their herbaria and see whether they do not recognize *Q. Texana*, chiefly masking as *Q. palustris*, and if so report at once to Dr. Sargent. The two plates in *Garden and Forest* will aid in ready recognition.

JUST AS THIS number is going to press we receive the sad announcement of the death on February 27th of Mr. John H. Redfield, the widely known curator of the Herbarium of the Philadelphia Academy of Sciences. Mr. Redfield was in his eightieth year. His remains were interred at Greenwood cemetery, Brooklyn.

Supplement to The Botanical Gazette.

RULES FOR CITATION

Adopted by the Madison Botanical Congress and Section G, A. A. A. S.

Writers and publishers of botanical matter are earnestly requested to adopt the forms here recommended. Examples of various citations illustrating the application of the rules in specific cases are given. Correspondence may be addressed to Secretary of the Committee on Bibliography, 1284 Massachusetts Ave., Cambridge, Mass.

In each complete citation there should be given the following items:

a. Author's surname in full, followed by a comma.

b. Exact title, verbatim, following the capitalization required by the usage of the language in which the title is written, but not necessarily the capitalization employed.

c. Name of periodical or work, abbreviated in accordance with list of journals and catalogue of authors under recommendation 1. *a. b.**

d. Series, if any, in Roman capitals.

e. Volume number in bold face Arabic numerals, followed by colon. In case there is no volume number, the number of the part, heft, lieferung, or fascicle is to occupy this place but is to be printed in Arabic numerals of ordinary face. When a volume is composed of parts separately paged the number of the part shall be written as an index figure to the volume number. Volumes in parts with continuous paging require no designation of parts.

f. Page, in Arabic numerals of ordinary face. In case paging of the paper is in Roman numerals these should be used, preferably small caps. Re-paging in reprints and separates is to be indicated by enclosing the numerals in parentheses. In case the original paging is unknown an em dash should occupy its place, the reprint paging being given in accordance with the foregoing

*See Proc. Mad. Bot. Cong. 45. Je 1894.

rule. No individual or unique paging is to be cited under any circumstances.

g. Figures, plates and exsiccatæ are to be printed in Italic Arabic numerals, the number designating the figure or plate to be preceded by the abbreviations *f.* and *pl.*, respectively, in Italics. *d.* following a page number may be used, when desired, to indicate description of a species.

h. Exact date must be given if possible, written in the mode and with the abbreviations for months used by Library Bureau.* The year at least must be given.

i. Punctuation. Except the comma following the author's name, and the colon following the volume number all the items are to be separated by periods. If another citation follows in the same line it is to be separated from the first by an en dash. Specific, generic and varietal names are to be written and punctuated in the method used in the "List of Pteridophyta and Spermatophyta" issued under the direction of the Botanical Club, A. A. A. S.

j. If it is considered desirable to give other data than series number (if any), volume number, page and date, these should be added in brackets after the date. But useless or unnecessary data should be avoided.

k. Citations of reviews, abstracts, and all such secondary references should be enclosed in parentheses.

Examples.

1. **Lagerheim, G. von.** Ueber das Vorkommen von Europæischen Uredineen auf der Hochebene von Quito. Bot. Centralb. **54**: 324–331. 1893.

2. **Trelease, W.** A revision of the American species of Epilobium occurring north of Mexico. Rept. Mo. Bot. Gard. **2**: 69–117. *pl. 1–48.* 22 Ap 1891.

3. **Sargent, C. S.,** Editor. Populus monticola. Gard. and For. **7**: 313. *f. 56.* 8 Ag 1894.

*Those abbreviations are as follows: Ja, F, Mr, Ap, My, Je, Jl, Ag, S, O, N, D; i. e., the initial of the month followed by the first distinctive letter.

4. **Dietel, P.** Die Gattung Ravenelia. Hedw. **33**:22–48. *pl. 1–5.* 30 Ja. 49–69. 15 Ap 1894.

The foregoing are correct forms for catalogue by author. The following illustrate cases arising under the rules indicated by the letter preceding.

5. Ell. and Everh. Pyren. 491. My 1892.

6. e. Proc. Phil. Acad. **1894**: 53–59. 1894.

The year number, 1894, is the volume number, and not necessarily the year of publication. E. g.,

7. e. Bessey, Am. Pomol. Soc. **1885**: 42. 1886.

8. e. **Mez, C.** Bromeliaceæ. III. Flora Brasiliensis 115: 425–634. *pl. 81–114.* 1F 1894.

Not Fasc. CXV, 425-634, t. 81-114.

9. e. **Saccardo, P. A.** Syll. Fung. 7^2: 481. N 1890.

10. e. j. Bull. Geol. and Nat. Hist. Surv. Minn. 9: 39–42. 2 Mr 1894.

Not 9^2; nor 9 part 2; nor 1894 [part 2].

11. e. j. Linn. Sp. Plant. 6^2: 125. 1852. [ed. Willd.]

12. e. j. **Gray, A.** Man. Bot. 225. 1890. [6th ed.]

13. f. **Peck, C. H.** Rep. N. Y. Mus. **47**: — (18). N 1894.

14. g. Ell. and Everh. N. A. F. *1642.* F 1889.

15. g. Rept. Mo. Bot. Gard. **2**: 98. *d. pl. 28.* 22 Ap 1891.

16. i. Beringer, Am. Jour. Pharm. **66**: 220. My 1894.—Tulasne, Ann. Sci. Nat. Bot. III. **7**: 85. *d. pl. 2. f. 3.* 1847.

17. j. **Bailey,** The Japanese plums in North America. Bull. Cornell Exp. Sta. 62: 3–36. Ja 1894. [Illust.]

The figures are not numbered.

18. k. Ell. and Kell. Jour. Myc. **1**: 12. *d.* Ja 1885.—(Hedw. **24**: 45 *d.* Je 1885.)—Peck, (Grev. **22**: 111. Je 1894.)

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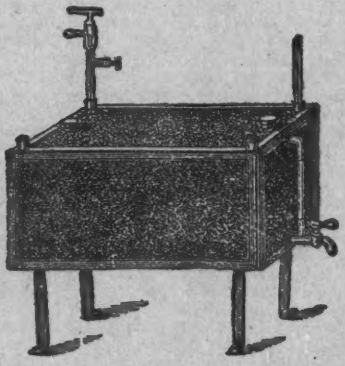

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